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STUDIES IN TROPICAL ASCOMYCETES—I

NEOPECKIA DIFFUSA AND HERPOTRICHIA ALBIDOSTOMA

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(WITH PLATE 19)

Through our own collections and the contributions or exchanges of others, an increasing amount of tropical material is continually coming to hand and it is the intention of the writer to publish from time to time notes on the more interesting species under the above general title. It is not the intention to restrict these notes to those species which are found in the tropics only but to include any forms which are of especial interest even though they may be cosmopolitan in their distribution as are the two which make up the subtitle of the present paper. These although frequently collected in the tropics were not originally described from tropical material, neither are they confined thereto, but have a very wide range of distribution.

On several occasions the attention of the writer has been called to the confusion which has resulted from the external similarity of the two above-named species while internally they are so different that they have been placed in different genera. As to the merits of the generic separation, the reader may judge for himself, the present paper being an attempt to emphasize the specific differences of the two species and to note some of the apparent synonyms and the wide range of distribution of the plants.

Several years ago the writer took the time to make microscopic examination of the spores of all of the specimens in the collection

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of the New York Botanical Garden under these names in order to separate the two species and found no difficulty in making the separation on microscopic characters. Chardon,[1] however, in his recent paper on the Pyrenomycetes of Porto Rico calls attention to the fact that Stevenson in his list of Porto Rican Fungi refers one of his numbers to *Herpotrichia albidostoma* and the other three to *H. diffusa,* while all of them agree in spore characters with the former. This is a fair illustration of the confusion which has always existed where determinations are made on superficial examination rather than on a detailed study of the spore characters, although the importance of this kind of work will scarcely be appreciated until one has taken the trouble to make comparative studies of a large number of specimens. Another fact which has been emphasized is the constancy of spore characters in specimens collected over a wide range of distribution including both temperate and tropical species.

Some of the gross characters common to the two species which are responsible for the existing confusion are: the subiculum of brown mycelium which is usually present but may be entirely wanting in older or weathered specimens, the light-colored usually reddish ostiola which are conspicuous but which may become discolored with age, and the gregarious or often rather congested habit of growth. The differences in spore characters are: size, form, color and septation. Since these characters, except color, can be shown better by illustration than by description, the reader is referred to the accompanying plate for illustrations of the spores of the two species made from specimens collected over a wide range.

Both species have been referred to the genus *Herpotrichia* and a word ought to be added regarding the generic position of *Neopeckia diffusa.* In 1912 while working over these specimens in our collections the writer had a rather extended correspondence with Peck regarding the generic position of *Herpotrichia rhodospiloides* Peck, maintaining that this species belonged to the genus *Neopeckia* rather than *Herpotrichia.* Later study showed this species to be identical with *Herpotrichia diffusa* which had already been

[1] Mycologia 13: 279–300. 1921.

placed in the genus *Neopeckia* by Starback,[2] thus confirming the contention of the writer. *Neopeckia* differs from *Herpotrichia* in that the spores are never more than 1-septate while in the latter they show a tendency to become more than 1-septate, although in the species under discussion they are only occasionally so.

We give below a description of the two species with a list of the apparent synonyms of each and some idea of the wide range of distribution. Attention is especially called to the close similarity in size and form of the spores from specimens collected in widely separated localities. While the specimens often vary in the amount of tomentum present, color, etc., the spores remain constant in size and form and without the spore characters it would be very difficult, if not impossible, to decide in many cases on the identity of the species.

NEOPECKIA DIFFUSA (Schw.) Starb. Bih. Sv. Vet.-Akad. Handl. **19** (3)[2]: 30. 1894

Sphaeria diffusa Schw. Trans. Am. Phil. Soc. II **4**: 210. 1832.
Sphaeria rhodomphala Berk. Hooker's Jour. Bot. **4**: 313. 1845.
Herpotrichia rhodomphala Sacc. Syll. Fung. **2**: 212. 1883.
Amphisphaeria subiculosa Ellis & Ev. Jour. Myc. **2**: 103. 1886.
Byssosphaeria diffusa Cooke, Grevillea **15**: 81. 1887.
Amphisphaeria diffusa Sacc. Syll. Fung. **9**: 747. 1891.
Herpotrichia rhodospiloides Peck, Bull. Torrey Club **36**: 154. 1909.

Perithecia gregarious, globose, seated on or involved in an effused, thin, black tomentum, subglabrous and dull reddish-brown or grayish at the apex, sometimes entirely black; ostiola obscurely lacerated; asci clavate or subcylindric, 60–100 μ long, 10–12 μ broad; spores crowded or subdistichous, oblong or fusoid, straight or slightly curved, 1-septate, usually with one or two oil-drops in each cell, hyaline, becoming pale-brown, 6–8 x 16–20 μ.

On dead wood and twigs.

TYPE LOCALITY: Bethlehem, Pennsylvania.

DISTRIBUTION: North America; Guadeloupe; Trinidad.

ILLUSTRATION: E. & P. Nat. Pfl. **1**: 396, *f. 255, H–J.*

EXSICCATI: N. Am. Fungi *2130* (as *Amphisphaeria subiculosa*), *2540* (as *Herpotrichia diffusa*); Fungi Columb. *2835* (as *Herpo-*

[2] Engler-Prantl, Nat. Pfl. 1[1]: 396.

trichia rhodospiloides), *3632* (as *Herpotrichia diffusa*); Baker Fungi Malayana *60*; Rab.-Wint.-Paz. Fungi Eu. *3960* (as *Herpotrichia diffusa*).

HERPOTRICHIA ALBIDOSTOMA (Peck) Sacc. Syll. Fung. 9: 857. 1891

Sphaeria albidostoma Peck, Ann. Rep. N. Y. State Mus. **32**: 51. 1879.

Herpotrichia incisa Ellis & Ev. Proc. Acad. Sci. Phila. **1893**: 130.

Perithecia numerous, subcrowded, subglobose, seated upon or involved in a black or blackish-brown tomentum, the ostiolum naked, not prominent, whitish when moist, darker when dry; asci cylindric or subcylindric; spores biseriate, oblong-fusoid, at first 1-septate, constricted at the septum, later often becoming indistinctly 3–5-septate, colorless, becoming pale-yellowish or brownish, 8–10 x 35–45 μ.

On dead wood or branches (type on *Acer spicatum*).

TYPE LOCALITY: Catskill Mountains, New York.

DISTRIBUTION: North America; Porto Rico; Trinidad.

EXSICCATI: C. L. Smith, Central American Fungi I (as *Herpotrichia diffusa*).

Nearly all of the specimens examined of this species have been distributed under one of the names applied to the preceding species, especially *Herpotrichia diffusa*.

EXPLANATION OF PLATE 19

NEOPECKIA DIFFUSA (Schw.) Starb. (spores)

Fig. 1. Specimen from the Schweinitz collection, no locality given.

Fig. 2. Arkansas, "Fungi Columbiani" *2835* (as *Herpotrichia rhodospiloides* Peck).

Fig. 3. Baker, "Fungi Malayana" *60*.

Fig. 4. Trinidad *2985*, collected by the writer.

Fig. 5. Trinidad *3084*, collected by the writer.

Fig. 6. Guadeloupe *260*, collected by P. Duss.

HERPOTRICHIA ALBIDOSTOMA (Peck) Sacc. (spores)

Fig. 7. Specimen from the Peck collection, apparently cotype, New York.

Fig. 8. Porto Rico *5586*, collected by J. A. Stevenson.

Fig. 9. Trinidad *3128*, collected by the writer.

Fig. 10. "Central American Fungi" *7*, distributed by C. L. Smith.

Fig. 11. Louisiana, Langlois *2463* (as *Herpotrichia duffusa* var. *rhodomphala* Berk.).

Fig. 12. Canada *1810*, collected by John Dearness (as *Herpotrichia incisa* Ellis & Ev.).

LIFE HISTORY OF AN UNDESCRIBED ASCOMYCETE ISOLATED FROM A GRANULAR MYCETOMA OF MAN

C. L. Shear

(With Text Figures 1–3)

In March 1921 we received from Dr. Mark F. Boyd of the Medical Department of the University of Texas, Galveston, Texas, cultures of a fungus showing perithecia and conidia for identification. This fungus was isolated from a lesion in a diseased ankle of a negro in Texas. The clinical history of this case with a general description of the organism has recently been published by Doctors Boyd and Crutchfield.[1] In brief the history of the case and of the organism is as follows:

Some twelve years ago the patient while barefooted ran a thorn into the sole of his foot. The thorn was removed and the wound apparently healed. About three months later the ankle began to

Fig. 1. *Allescheria boydii*. *a*, Cephalosporium stage, conidiophores and conidia × 277; *b*, conidia, × 530.

pain and became swollen. The swelling became soft and finally ruptured, discharging bloody pus. The lesions healed over temporarily, but continued to break at intervals. Soon after the pa-

[1] Boyd, Mark F., & Cutchfield, Earl D. Contribution to the Study of Mycetoma in North America. Am. Jour. of Trop. Med., 1, no. 4, 215–289, July, 1921.

tient was admitted to the hospital, which was 12 years subsequent to the thorn wound, the diseased tissues were washed out and found to contain granules. These granules when crushed and examined with a microscope and also when sectioned showed the presence of fungous hyphae. Portions of these granules when transferred to culture media produced an abundant growth of an apparently pure culture of the organism under discussion.

The history of the case and the nature of the fungus appear to indicate that this organism was probably introduced into the foot with the thorn, and that it had remained there and was perhaps the chief contributing cause of the pathological condition which developed later. Inoculation experiments conducted by Dr. Boyd with guinea pigs were not successful in producing pathological effects of the mycetoma type, the reactions observed in such cases being only such as would be expected from the introduction of a foreign body into the tissues. As the fungus does not appear to be an anaërobic organism, it is difficult to understand how it could have continued to live and develop for so long a period within the tissues of the foot and ankle before any lesion occurred.

Upon receiving the cultures of the fungus, sub-cultures in poured plates were made to isolate ascospores and conidia and to determine the life history of the organism and the genetic relations of the three forms of fructification found. This was soon done as the fungus develops readily on ordinary culture media, such as cornmeal agar or glycerine agar, and in a few weeks produces all the spore forms, beginning with conidia, which are regularly followed by perithecia. The coremia (fig. 3) are not so uniform and regular in appearance as the other spore forms and sometimes do not develop until after perithecia have appeared. In culture on cornmeal agar, colonies developed from spores are white at first, soon becoming gray and with a radiate, fimbriate margin. As conidia begin to form at the center the color becomes pale greenish-ochraceous and the surface has much the same appearance as a culture of *Cladisporium herbarum*. As the cultures become older the growth becomes darker colored and more or less smoky-brown. In a couple of weeks at ordinary laboratory temperatures an abundance of small, globose, cleistogamous perithecia are produced just

beneath or on the surface of the agar. The fungus evidently is related to the same general group of ascomycetes to which *Eurotium* belongs.

The first conidia are borne on loose-branched, spreading hyphae on lateral as well as terminal, short branches or sporophores, as shown in fig. 1 *a*. The spores are nearly hyaline, non-septate, rather variable in form and size, and are held together in groups or small masses at the apex of the sporophore by their mucous envelope. The perithecia have a thin, membranaceous wall without an ostiole. The manner in which the asci arise has not been determined. The perithecia appear to be filled at first with a granular protoplasm which becomes vacuolate as shown in fig. 2 *a*, and the young asci begin to develop toward the center. No signs

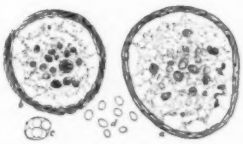

FIG. 2. *Allescheria boydii*. *a*, Median section of a perithecium showing young asci; *b*, submedian section showing a nearly mature ascus with ascospores × 530; *c*, single ascus; *d*, ascospores, × 750.

of hyphae have been observed in the perithecia. The asci become free and the ascus wall disappears as soon as the spores are mature. The coremium form is of the type which has been described by v. Hoehnel as *Dendrostilbella*. The synnema consist of smoky-brown, parallel hyphae which expand at the top to form the coniferous head. The fertile hyphae of the head branch in more or less dendroid sporophores, producing the conidia at the apex of the ultimate branches. These conidia are all so similar in form, size and color that they cannot easily be distinguished from the earlier conidia produced on effuse hyphae.

The fungus is evidently most closely related to the organism described by Costantin in 1896[2] as *Eurotiopsis gayoni*, which was found growing on meal and other organic substances at Paris. As

[2] Costantin, J. Eurotiopsis, Nouveau genre d'Ascomycetes. Bull. Soc. Bot. France, 40: 2d Ser. 15: 236–238, M. 1893.

the name *Eurotiopsis* had already been used for an entirely different fungus, Saccardo substituted the generic name *Allescheria*. The fungus described here differs from Costantin's species in producing coremia, in having larger perithecia, asci, ascospores and conidia and the latter noncatenulate. We regard it as an undescribed species and have named it *Allescheria boydii* in honor of Dr. Boyd, the discoverer.

Its characters are as follows:

Allescheria boydii sp. nov.

I. Perithecia numerous, crowded, covering the surface of the medium, usually erumpent or subsuperficial, globose, thin, membranous, dark-brown astomate, 100–200 μ in diam.; asci globose or subglobose, thin walled, evanescent at maturity, 10–20 μ in diam.; paraphyses none; ascospores 8, globose to subglobose or somewhat ovoid, continuous, smooth, pale yellowish-brown when mature, globose form about 7 μ in diam., other mostly 5.5–7 x 4–4.5 μ.

II. Pycnidia unknown or wanting.

III[a]. Byssoid conidial form, *Cephalosporium boydii*, thin, floccose, white at first, soon gray, margin radiate-fimbriate, later changing to pale greenish-ochraceous as sporulation begins, fertile hyphae much branched, spreading, conidiophores lateral or terminal mostly short; conidia adhering in small or large subglobose masses, continuous, subglobose to oblong elliptical, very variable in size and shape, hyaline at first becoming pale, yellowish-brown when old, smooth, 8–15 x 4–7.5 μ, mostly 10–12 x 5–6 μ.

III[b]. Coremia (*Dendrostilbella boydii*) with dark brown synnema very variable in height and thickness, 200–300 μ or more high, head subglobose; sporophores alternately branching, ultimate branches once or twice the length of the conidia; conidia practically same size, shape and color as in the byssoid condition and adhering in a globular mass after abstriction.

Isolated from a lesion in a human ankle, by Dr. Mark F. Boyd, Galveston, Tex., 1921. Type: Slides no. 32921*a*, *Cephalosporium* form; 32921*b*, *Dendrostilbella* form; 32921*c*, *Perithecia*.

For greater convenience in referring to the various spore stages of the pleomorphic ascomycetes, we have adopted the Roman numerals used by uredinologists with some modifications to meet the different conditions. I indicates an ascogenous fructification, as a perithecium or apothecium; II indicates a pycnidial fructifica-

tion; and III a conidial stage. Where more than one conidial form occurs in the life cycle of a species, as in the present case, this may be indicated by the use of an alphabetical exponent, as III^a and III^b, and the same may be used where more than one pycnidial form occurs, thus in macro- and micro-pycnidia the former would be II^a and the latter II^b. We have used I for the ascogenous stage, because of the rather uniform, present practice in pleomorphic species of describing this stage first. It should go without saying that no idea of homology with the rusts is to be inferred from the use of similar symbols.

FIG. 3. *Allescheria boydii*. *a*, Dendrostilbella stage, × 277; *b*, conidiophore of same with young conidia, × 530; *c*, conidia of same, × 530.

Binomial names are suggested for the conidial forms of this fungus, because in the present state of our knowledge of the genetic relationships of the various form-genera, it seems necessary to use separate binomials in referring to conidial and pycnidial forms when found separate and there is doubt as to their ascogenous stage. When our knowledge of life cycles is as complete as it is in the rusts, we should be able to discard form-genera and use only the one binomial name and the symbols to indicate the different spore forms.

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NOTES ON SOME SPECIES OF COLEOSPORIUM—I

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(WITH PLATES 20 AND 21)

In a series of two papers it is proposed to give in brief detail hitherto unpublished data including the results of many sets of inoculations with the aecial, uredinial, and telial stages of a number of species of *Coleosporium*. Many negative results are given because of a theory that has been advanced, at least privately by some investigators, that in the eastern United States we probably have only two or three species of *Coleosporium*. That there are species of pine which act as natural bridging hosts which, if infected by a given species of *Coleosporium* from a certain host plant, may bear aecia whose aeciospores are capable of infecting other host plants and producing a second species of *Coleosporium*. This theory would ascribe to a species of pine the power to change the nature of a rust to such an extent that it is able to infect host plants which the urediniospores of the rust may not be able to infect. Negative results have at least some value in proving or disproving a theory, that value being determined largely by the number of cases given, and the care with which the results are obtained. None of the species of pine reported in this paper appear to be bridging hosts, in the light of the results obtained from our experiments.

COLEOSPORIUM HELIANTHI AND COLEOSPORIUM INCONSPICUUM

The forms of *Coleosporium* occurring on species of *Coreopsis*, *Helianthus*, *Verbesina* and *Viguiera* in North America were originally assigned by Prof. J. C. Arthur to *Coleosporium helianthi* (Schw.) Arthur in 1907.[1] *Peridermium inconspicuum* Long was discovered and named by Dr. W. H. Long in 1912.[2] The proof

[1] Arthur, J. C. North American Flora, Uredinales, Coleosporiaceae. 7: 93. 1907.

[2] Long, W. H. Two New Species of Rusts. Mycologia 4: 283, 284. 1912.

of the connection of this aecial form with the *Coleosporium* on species of *Coreopsis* in 1913[3] led to the separation of *Coleosporium inconspicuum* (Long) Hedgc. & Long from *Coleosporium helianthi*. The discovery of the aecial form of *Coleosporium helianthi* by the senior writer in 1914, and the publication of the proof of its relation to the *Coleosporium* on species of *Helianthus* in 1917,[4, 5] leaves in the eastern United States the forms of *Coleosporium* on *Verbesina* and *Viguiera* without proven aecial forms.

INOCULATIONS WITH COLEOSPORIUM HELIANTHI

The superficial resemblance of the aecia of *Coleosporium helianthi* (Pl. 20, fig. 2) to those of *Coleosporium inconspicuum* (Pl. 20, fig. 1) has necessitated extensive inoculations with the aeciospores from both forms, the results of which will now be given.[6] Fortunately several of the earlier collections of the aecia of *Coleosporium helianthi* were from localities either where species of *Coreopsis* were not present, or were not infected with *Coleosporium* if present, and several collections of *Coleosporium inconspicuum* were obtained from localities either where species of *Helianthus* were not present, or if present were not infected. This afforded an opportunity to experiment with reasonably pure natural stocks of each rust. Later these results were verified by the use of aeciospores from pedigreed aecia obtained by inoculating in separate experiments trees of *Pinus virginiana* with the telia of each species of *Coleosporium*.

From 1914 to 1921, twelve sets of inoculations were made with the aeciospores of *Coleosporium helianthi* and from 1915 to 1921, fourteen sets with those of *C. inconspicuum* in the greenhouses at Washington, D. C. As in all our inoculation experiments with aeciospores and urediniospores of species of *Coleosporium*, the

[3] Hedgcock, G. G., & Long, W. H. Notes on Cultures of Three Species of *Peridermium*. Phytopathology 3: 250, 251. August, 1913.

[4] Hedgcock, G. G., & Hunt, N. R. An Alternate Form for *Coleosporium helianthi*. Phytopathology 7: 67, 68. February, 1917.

[5] Hedgcock, G. G., & Hunt, N. R. New Species of *Peridermium*. Mycologia 9: 240, 241. July, 1917.

[6] Dr. Wm. H. Long assisted the senior writer during 1913 and 1914, and Mr. N. Rex Hunt from 1915 to 1918.

spores were either placed or allowed to fall on the moistened surfaces, especially the under one, of the leaves; the plants were then kept in moist chambers or iceless refrigerators[7] 2 to 4 days, then placed in rooms or compartments of the greenhouse separate from plants inoculated with other species of *Coleosporium*. In inoculations with sporidia, whole infected plants or the leaves of infected plants were either suspended over the pine trees or laid on a wire netting over them in a large moist chamber or an iceless refrigerator for 2 to 4 days. The iceless refrigerator is the best form of inoculating chamber that we have used, more especially in warm weather. An equal number of control plants were placed uninoculated under similar conditions, apart from the inoculated sets of plants. Plants grown from healthy cuttings or from seed in the greenhouses were used. In each experiment given in this series of papers the control plants remained healthy.

In the aecial inoculations with *Coleosporium helianthi*, aeciospores from aecia collected[8] on *Pinus virginiana* from the following localities were used separately in the experiments: Greenwood Furnace, Pa.; Washington, D. C.; Chain Bridge, Va.; Black Mountain and Marion, N. C.; Greenville, S. C.; and Rome, Ga. Plants as follows were inoculated: 1 *Aster cordifolius*,[9] 1 *A. laevis*, 1 *A. undulatus*, 9 *Coreopsis major*, 10 *C. verticillata*, 1 *C. tripteris*, 1 *Chrysopsis mariana*, 16 *Helianthus decapetalus*, 6 *H. divaricatus*, 2 *H. dowellianus*, 1 *H. giganteus*, 2 *H. glaucus*, 16 *H. hirsutus*, 3 *H. microcephalus*, 2 *H. radula*, 1 *Laciniaria elegans*, 3 *Parthenium integrifolium*, 1 *Rudbeckia laciniata*, 2 *Silphium asteriscus*, 2 *S. integrifolium*, 1 *S. perfoliatum*, 1 *S. trifoliatum*,

[7] Hunt, N. Rex. The "Iceless Refrigerator" as an Inoculation Chamber. Phytopathology **9**: 211–212. May, 1919.

[8] Unless otherwise credited all collections used in inoculations and noted in this series of papers were made by the senior writer.

[9] Unless the authority is designated, the names used for species of plants from the southeastern United States are those used by Small, J. H., Flora of the Southeastern United States, 1913. For those from the northeastern United States, Britton, N. L., & Brown, A., Illustrated Flora of the Northeastern United States, etc., 1898. For those from the Rocky Mountain region, Rydberg, P. A., Flora of Colorado. For those from the northwestern United States, Piper, C. V., Flora of Washington, Contributions from the National Herbarium, Vol. XI, 1906.

1 *Solidago canadensis*, 2 *Verbesina virginica* and 1 *Vernonia noveboracensis*. Of these plants, only those of species of *Helianthus* became infected, bearing mature uredinia in 12 to 15 days and mature telia in 6 weeks to 2 months. The number of plants infected of each species was as follows: 5 *H. decapetalus*, 3 *H. divaricatus*, 1 *H. giganteus*, 2 *H. glaucus*, 13 *H. hirsutus*, 1 *H. microcephalus* and 2 *H. radula*. On the last-named species the rust is now reported for the first time. Of the 20 plants of species of *Coreopsis* inoculated, none were infected.

Inoculations were made with the urediniospores of *Coleosporium helianthi* from *Helianthus hirsutus* obtained from previous inoculations June 10, 1919, on the following plants: 2 *H. hirsutus*, 2 *H. radula*, 2 *Coreopsis major* and 4 *C. verticillata*. All the plants of *Helianthus* became infected, bearing mature uredinia June 26 and telia July 20. All plants of *Coreopsis* remained free from infection.

Pine trees were inoculated September 29, 1920, with the sporidia from the telia of *Coleosporium helianthi* on *Helianthus decapetalus* collected the previous day near Chain Bridge, Va. The following trees were inoculated: 1 *P. caribaea*, 1 *P. edulis* Engelm., 1 *P. glabra*, 2 *P. radiata* Don. and 8 *P. virginiana*. Seven trees of the last-named species were infected, many mature pycnia appearing on the needles by March 21, 1921, and abundant mature aecia by April 20. The other trees remained uninfected.

Aeciospores of *Coleosporium helianthi* from the preceding experiment were inoculated April 20, 1921, on the following plants: 1 *Coreopsis major*, 2 *C. verticillata*, 1 *Helianthus divaricatus* and 2 *H. hirsutus*. Only the three plants of *Helianthus* were infected with the *Coleosporium*, producing both the uredinial and telial stages.

INOCULATIONS WITH COLEOSPORIUM INCONSPICUUM

In the aecial inoculations with *Coleosporium inconspicuum*, aeciospores from aecia collected on *Pinus virginiana* from the following localities were used separately in the experiments: Takoma Park, Md.; Washington, D. C.; Roanoke, Va.; Asheville, Black Mountain and Hot Springs, N. C. Plants as follows were inocu-

lated: 1 *Chrysopsis mariana*, 1 *Coreopsis lanceolata*, 16 *C. major*, 1 *C. tripteris*, 26 *C. verticillata*, 1 *Elephantopus carolinianus*, 10 *Helianthus decapetalus*, 1 *H. divaricatus*, 2 *H. dowellianus*, 1 *H. glaucus*, 10 *H. hirsutus*, 4 *H. microcephalus*, 1 *H. occidentalis*, 1 *H. tuberosus*, 1 *Laciniaria elegans*, 2 *Silphium integrifolium*, 4 *Verbesina virginica*, 2 *Vernonia blodgettii*, 3 *V. flaccidifolia*, 1 *V. glauca*, 2 *V. oligantha* and 2 *V. noveboracensis*. Of these plants, only those of species of *Coreopsis* became infected, many of them abundantly, bearing mature uredinia in 13 to 16 days, and mature telia in about 2 months. The number of plants of each species infected was as follows: 1 *C. lanceolata*, 7 *C. major*, 20 *C. verticillata* and 1 *C. tripteris*.

Aeciospores of *Coleosporium inconspicuum* from aecia on *Pinus echinata* collected near Mt. Airy, N. C., were used March 22, 1919, to inoculate plants as follows: 2 *Coreopsis major*, 1 *C. verticillata* and 1 *Helianthus hirsutus*, and on the same date a duplicate set of plants was inoculated with aeciospores from a collection of aecia on *Pinus palustris* made near Styx, S. C., May 11. In each of these two experiments, only the plants of *C. verticillata* became infected with the *Coleosporium*, proving it to be *C. inconspicuum* in each case.

Pine trees were inoculated September 29, 1920, with the sporidia from the telia of *Coleosporium inconspicuum* on *Coreopsis verticillata*, collected the preceding day in Virginia, near Washington, D. C. The following trees were inoculated: 1 *Pinus glabra*, 4 *P. virginiana*. All the trees of the latter species were infected, bearing mature pycnia on the needles by March 2, 1921, and mature aecia by April 20.

Aeciospores of *Coleosporium inconspicuum* from the preceding experiment were inoculated April 20, 1921, on the following plants: 1 *Coreopsis major*, 6 *C. verticillata* and 2 *Helianthus hirsutus*. The one plant of *C. major* and 4 of *C. verticillata* were infected with the *Coleosporium*, producing both the uredinial and telial stages.

All our inoculations fail to furnish the slightest proof that *Coleosporium helianthi* and *C. inconspicuum* are identical physiologically, but on the contrary indicate that they are distinct species.

The aecial forms of the two species do not differ widely in morphology, as is shown by the following table:

TABLE OF COMPARISON

Coleosporium helianthi	*Coleosporium inconspicuum*
Pycnia solitary or few, clustered, deep chrome[10] to raw umber. When fresh, 0.38 mm. wide by 0.5 mm. long.[11]	*Pycnia* few to many, in extended rows, yellow ochre to Dresden brown when fresh, 0.28 mm. wide by 0.64 mm. long.
Aecia solitary or few, aggregated, linguaform to flattened rhomboidal. 0.9 mm. high by 1 mm. long (plate 20, fig. 2).	*Aecia* few to many, aggregated or in short rows, tubular to linguaform, 0.9 mm. high by 0.6 mm. long (plate 20, fig. 1).
Peridial cells 17 by 36 μ, walls 5 μ thick.	*Peridial cells* 20 by 38 μ, walls 4 μ thick.
Aeciospores 16 by 27 μ, walls 2.6 μ thick.	*Aeciospores* 15 by 25 μ, walls 2.4 μ thick.

The pycnia of *Coleosporium inconspicuum* are slightly darker in color, and the aecia are more nearly tubular (Plate 20, fig. 1) than those of *Coleosporium helianthi*, which are more commonly flattened (Plate 20, fig. 2).

THE COLEOSPORIUM ON VERBESINA

The *Coleosporium* occurring on *Verbesina* has been assigned by Prof. Arthur to *Coleosporium helianthi*. In the experiments already mentioned with aeciospores of both *C. helianthi* and *C. inconspicuum* all plants of *Verbesina* failed of infection. The following inoculations were made with the *Coleosporium* from *Verbesina* obtained in Florida:

March 12, 1914, urediniospores from a collection made by Dr. Long at New Smyrna, March 9, were used to inoculate the following plants without infection: 1 *Elephantopus carolinianus*, 2 *E. tomentosus*, 1 *Solidago bicolor*, 2 *S. juncea* and 1 *Vernonia glauca*.

March 11, 1915, urediniospores from a collection by the senior writer in the same locality, March 4, were used to inoculate successfully 3 plants of *Verbesina virginica*, which bore uredinia

[10] Colors used are those of Ridgway, R. Color standards and nomenclature. Washington, D. C. 1912.

[11] Measurements are based on an average of 60, 10 each for six different collections.

March 30 and telia May 25. April 28, 18 plants of *Verbesina* were successfully inoculated with urediniospores from the previous culture, bearing mature uredinia in 14 to 18 days and telia in about 2 months.

In 1919, urediniospores were again obtained from a collection by Dr. Long at East Palm Beach, and the following plants were inoculated: 2 *Coreopsis verticillata*, 4 *C. major*, 2 *Elephantopus carolinianus*, 4 *H. decapetalus*, 6 *H. hirsutus*, 3 *H. radula*, 2 *Silphium asteriscum*, 2 *S. integrifolium*, 13 *Verbesina virginica* and 2 *Vernonia flaccidifolia*. Only the plants of *Verbesina* were infected, bearing mature uredinia in 14 to 17 days and telia in about 2 months.

Since the urediniospores of this *Coleosporium* from *Verbesina* do not infect plants of species of *Coreopsis, Elephantopus, Helianthus, Silphium, Solidago* and *Vernonia*, it appears it does not belong to any of the species of *Coleosporium* attacking these plants, viz., *C. inconspicuum, C. helianthi, C. terebinthinaceae, C. solidaginis* and *C. carneum*, and it is predicted that it has a distinct aecial form not yet collected or known.

DISTRIBUTION OF THE SPECIES

Coleosporium helianthi, according to our records, has been collected in the United States as follows:

O and I on *Pinus:*

P banksiana: Michigan.

P. echinata: Georgia.

P. virginiana: Maryland, Pennsylvania, North Carolina, South Carolina, Tennessee, Virginia and West Virginia.

II and III on *Helianthus:*

H. australis: North Carolina.

H. decapetalus: Indiana, Maryland, New York, North Carolina, South Carolina, Pennsylvania, Tennessee and Virginia.

H. divaricatus: District of Columbia, Georgia, North Carolina, Pennsylvania, Tennessee and Virginia.

H. doroconoides: Ohio and Minnesota.

H. eggertii: Tennessee.

H. giganteus: Alabama, Mississippi, New York, Pennsylvania and West Virginia.

H. glaucus: Georgia and Tennessee.

H. grosseserratus: North Carolina and West Virginia.

H. microcephalus: Alabama, Georgia, North Carolina, South Carolina, Tennessee and Virginia.

H. occidentalis: Louisiana.

H. saxicola Small: Georgia.

H. strumosus: Alabama.

H. tuberosus: Alabama, South Carolina and Virginia.

Coleosporium helianthi has been successfully inoculated upon the following species: *Pinus virginiana, Helianthus decapetalus, H. divaricatus, H. glaucus, H. microcephalus* and *H. radula.*

Coleosporium inconspicuum, according to our records, has been collected in the United States as follows:

O and I on *Pinus:*

P. echinata: Georgia and North Carolina.

P. palustris: South Carolina.

P. virginiana: District of Columbia, Georgia, Maryland, North Carolina and Virginia.

II and III on *Coreopsis:*

C. delphinifolia: Tennessee.

C. lanceolata: North Carolina and Tennessee.

C. major: Georgia, North Carolina, South Carolina and Tennessee.

C. major oemleri: Georgia, North Carolina, Tennessee and Virginia.

C. major rigida: Georgia, North Carolina and Tennessee.

C. tripteris: Georgia and Tennessee.

C. verticillata: District of Columbia, Maryland, North Carolina and Virginia.

Coleosporium inconspicuum has been successfully inoculated upon the following species: *Pinus virginiana, Coreopsis lanceolata, C. major, C. verticillata* and *C. tripteris.*

From the foregoing data, it will readily be seen that *Coleosporium helianthi* has a much wider known distribution in the United States than *Coleosporium inconspicuum,* as it ranges from Minnesota and New York on the north to Louisiana and Georgia on the south, as compared with a range for *C. inconspicuum* from Maryland and Michigan south to Georgia and west to Tennessee.

COLEOSPORIUM TEREBINTHINACEAE

Coleosporium terebinthinaceae (Schw.) Arthur was first described in the uredinial stage as *Uredo terebinthinaceae* by Schweinitz[12] in 1822. It was transferred to the genus *Coleosporium* by Professor Arthur[13] in 1907. The aecial form was discovered by the senior writer in 1916, and described in 1917.[14]

[12] Schweinitz, L. D. Synopsis Fungorum Carolinae Superoris. Schrift. Naturf. Ges. Leipzig 1: 70. 1822.

[13] Arthur, J. C. North American Flora, Uredinales, *Coleosporium.* 7: 93. 1907.

[14] Hedgcock, Geo. G., & Hunt, N. Rex. New Species of *Peridermium.* Mycologia 9: 240. 1917.

In the study of *Coleosporium terebinthinaceae* the following inoculations have been made:

During May, 1916, and April, 1918, 7 sets of separate inoculations were made with aeciospores from collections made on *Pinus echinata* at Auburn, Ala.; Gainesville, Ga.; Clearwater, S. C.; and Marion, N. C. Plants of the following species were inoculated: 3 *Amsonia ciliata*, 2 *Coreopsis verticillata*, 2 *Laciniaria gramifolia*, 10 *Parthenium integrifolium*, 1 *Silphium asteriscus*, 13 *S. integrifolium* and 3 *S. trifoliatum*. The following plants were infected, some of them heavily, bearing mature uredinia in 11 to 13 days and telia in about 2 months: 1 *Silphium asteriscus*, 4 *S. integrifolium*, 3 *S. trifoliatum* and 1 *Parthenium integrifolium*.

Urediniospores obtained from *Silphium integrifolium* in one of the preceding inoculations were used June 27, 1916, to inoculate plants as follows: 2 *Silphium integrifolium*, 1 *S. trifoliatum* and 2 *Parthenium integrifolium*. One plant each of *S. integrifolium* and *S. trifoliatum* were infected heavily, bearing mature uredinia in 13 days and mature telia in about 2 months.

A number of inoculations were made with telia on several species of pine during 1915 and 1916 without infection.

Although plants of but few species have been tested by inoculation with the aeciospores of *C. terebinthinaceae*, a large number of plants of species of *Silphium* and *Parthenium* susceptible to this species of *Coleosporium* have been tested, without infection, by inoculation with the aeciospores of the following species of *Coleosporium*: *C. carneum* (Bosc.) Jackson, *C. elephantopodis* (Schw.) Thüm., *C. helianthi* (Schw.) Arthur, *C. inconspicuum* (Long) Hedgc. & Long, *C. ipomoeae* (Schw.) Burrill, *C. minutum* Hedgc. & Hunt, and *C. solidaginis* (Schw.) Thüm.

Coleosporium terebinthinaceae according to our records has been collected in the United States as follows:

O and I on *Pinus*:
P. echinata: Alabama, Georgia, North Carolina and South Carolina.
P. palustris: South Carolina.
P. rigida: North Carolina.
P. serotina: South Carolina.
P. taeda: Alabama and South Carolina.
II and III on *Parthenium* and *Silphium*:
P. integrifolium: Alabama, Georgia, North Carolina, Tennessee and Virginia.

S. angustatum: Alabama, Georgia and South Carolina.
S. asperrimum: Texas.
S. asteriscus: Georgia, Louisiana, North Carolina and South Carolina.
S. compositum: Alabama, Georgia, North Carolina, Tennessee and Virginia.
S. dentatum: Georgia, North Carolina and South Carolina.
S. glabrum Eggert: Georgia and Tennessee.
S. gracile: Texas.
S. integrifolium: Alabama, Arkansas, Georgia, Illinois, Indiana, Louisiana, Mississippi and Missouri.
S. laciniatum: Iowa and Kansas.
S. laevigatum: Alabama.
S. pinnatifidum: Georgia.
S. scaberrimum: Texas.
S. terebinthinaceum: Illinois, Indiana and North Carolina.
S. trifoliatum: Alabama, North Carolina and Virginia.

Coleosporium terebinthinaceae has been successfully inoculated upon *Parthenium integrifolium, Silphium asteriscus, S. integrifolium,* and *S. trifoliatum.*

The aecial stage of this *Coleosporium* is a small species, resembling somewhat *C. laciniariae* Arthur, *C. helianthi*[15] and *C. inconspicuum.*

A comparison of the morphology of *Coleosporium terebinthinaceae* with that of *C. laciniariae* follows:

TABLE OF COMPARISON

Coleosporium terebinthinaceae	*Coleosporium laciniariae.*
Pycnia solitary or few, usually in short rows, orange-rufous to mummy-brown when fresh, on olive-yellow spots, 0.2 mm. wide by 0.4 mm. long.	*Pycnia* solitary or few, usually aggregated, salmon-orange to olivaceous-black when fresh, on light-green spots, 0.4 mm. wide by 0.6 mm. long.
Aecia solitary to few, usually in short rows, linguaform to flattened rhomboidal, 1.4 mm. high by 1.1 mm. long.	*Aecia* solitary to few, usually aggregated, flattened rhomboidal, 0.4 mm. high by 1.5 mm. long.
Aeciospores 20 by 30 μ with walls 3 μ thick.	*Aeciospores* 20 by 31 μ with walls 2 μ thick.
Peridial cells 26 by 53 μ with walls 4 μ thick.	*Peridial cells* 25 by 40 μ with walls 5 μ thick.

The pycnia of *Coleosporium terebinthinaceae* are brown and those of *C. laciniariae* are black at the time when the aecia are beginning to appear. It is possible at this stage to determine most

[15] For a comparison with the aecial stages of *C. helianthi* and *C. inconspicuum,* see the "Table of Comparison" on another page of this article.

of the species of *Coleosporium* in the eastern United States from pycnial characters, where freshly collected specimens are available.

COLEOSPORIUM DELICATULUM

Coleosporium delicatulum (Arthur & Kern) Hedgc. & Long was first described in the aecial stage by Arthur and Kern[16] in 1906 as *Peridermium delicatulum*. Proof of the connection of the aecial stage on *Pinus rigida* with the uredinial stage on *Euthamia graminifolia* was obtained by Dr. Long and the senior writer[17] and published in 1913.

Inoculations with *Coleosporium delicatulum* have since been made as follows: During April and May, 1913, nine sets of inoculations were made with aeciospores from collections of aecia made on *Pinus rigida* near Takoma Park, D. C. The following plants were inoculated: 1 *Aster conspicuus*, 2 *A. cordifolius*, 3 *A. ericoides*, 1 *A. hesperius*, 1 *A. laevis geyeri*, 3 *A. lenta*, 1 *A. paniculatus*, 3 *A. undulatus*, 14 *Euthamia graminifolia*, 2 *Helianthus divaricatus*, 1 *Ribes nigrum*, 4 *Senecio aureus*, 4 *Solidago bicolor*, 2 *S. canadensis*, 2 *S. erecta*, 5 *S. juncea*, 2 *S. multiradiata* Ait., 3 *S. rugosa* and 1 *S. speciosa*. Of these plants only those of *Euthamia graminifolia* were infected, having mature uredinia in 14 to 16 days and telia in about 2 months.

During May and June, 1914, three sets of inoculations were made with aeciospores from the same source as in 1913. Plants of the following species were inoculated: 1 *A. laevis*, 3 *A. laevis geyeri*, 1 *A. undulatus*, 1 *Elephantopus tomentosus*, 18 *Euthamia graminifolia*, 1 *Helianthus occidentalis*, 2 *Solidago canadensis*, 2 *S. multiradiata*, 3 *S. rugosa* and 2 *Vernonia noveboracensis*. Of these plants only those of *Euthamia* were infected and bore uredinia and telia as in the preceding experiments.

Aeciospores from aecia collected on *Pinus palustris* by Dr. Long at Brooksville, Fla., March 27, were used April 3, 1914, to inoculate plants of the following species: 3 *Euthamia graminifolia*, 1 *Eupatorium maculatum* and 1 *Solidago rugosa*. The plants of *Euthamia* were infected and bore uredinia and telia as before.

[16] Arthur, J. C., & Kern, F. D. North American Species of *Peridermium*. Bul. Torrey Bot. Club 33: 404. 1906.

[17] Hedgcock, Geo. G., & Long, W. H. Notes on Cultures of Three Species of *Peridermium*. Phytopathology 3: 250. 1913.

April 3, 1914, aeciospores from aecia collected on *Pinus scrotina* by Dr. Long at St. Augustine, Fla., March 30, were used to inoculate plants of the following species: 2 *Euthamia graminifolia* and 2 *Solidago rugosa*. Only the plants of *Euthamia* were infected and bore uredinia and telia as before.

During March and April, 1914, aeciospores from aecia collected on *Pinus taeda* by Dr. Long at Brooksville and St. Augustine, Fla., and Henry, S. C., were used to inoculate plants of the following species: 9 *Euthamia graminifolia*, 1 *Helianthus annuus*, 1 *Solidago rugosa* and 3 *S. speciosa*. Only the plants of *Euthamia* became infected and bore uredinia and telia as before.

During April, 1915, aeciospores from aecia collected on *Pinus echinata* at Florence, S. C., were used to inoculate and infect 1 plant of *Euthamia caroliniana* and 2 of *E. graminifolia*, which as a result bore uredinia and telia. Also aeciospores from aecia collected on *Pinus caribaea* at Jacksonville, Fla., were used to infect 3 plants of *Euthamia graminifolia* which bore uredinia and telia as before.

During June, 1916, aeciospores from aecia on *Pinus resinosa* collected by Dr. P. Spaulding at Sharon, Vt., were used to infect *Euthamia graminifolia*, which as a result bore uredinia and telia. Plants of *Euthamia* infected during 1914, 1915, and 1916, bore mature uredinia in 11 to 18 days and mature telia in 5 to 8 weeks.

Inoculations with the sporidia from the telia of *Coleosporium delicatulum* have been made on pine trees as follows:

September 11, 1916, the following were inoculated with sporidia from telia collected September 10 near Takoma Park, D. C.: 1 *Pinus caribaea*,[18] 2 *P. clausa*, 1 *P. contorta*, 1 *P. coulteri*, 1 *P. densiflora* Thunb., 2 *P. echinata*, 2 *P. edulis*, 3 *P. glabra*, 2 *P. mayriana* Sudw., 1 *P. monophylla*, 1 *P. montana* Mill., 1 *P. palustris*, 2 *P. rigida*, 1 *P. scopulorum*, 2 *P. serotina*, 2 *P. taeda* and 1 *P. thunbergii* Parl. Of these trees the following were infected, bearing mature pycnia in January and mature aecia in March, 1917: 1 *P. contorta*, 2 *P. echinata*, 2 *P. glabra*, 1 *P. mayriana*, 1 *P. palustris*, 2 *P. rigida*, 2 *P. serotina* and 1 *P. taeda*.

[18] In these two papers, *P. heterophylla* is considered synonymous with *P. caribaea*, and *P. murrayana* with *P. contorta*.

October 13, 1920, sporidia from telia on *Euthamia graminifolia*, collected the same day near Chain Bridge, D. C., were used to inoculate trees of the following species in pots sunk in beds outside of the greenhouses: 1 *Pinus canariensis* C. Smith, 3 *P. caribaea*, 7 *P. contorta*, 3 *P. coulteri*, 2 *P. echinata*, 1 *P. edulis*, 1 *P. glabra*, 1 *P. mayriana* and 2 *P. scopulorum*. Of these the following were infected, bearing mature pycnia in March and mature aecia late in April, 1921: 1 *P. caribaea*, 1 *P. coulteri* and 2 *P. scopulorum*.

The pycnial stage of *Coleosporium delicatulum* resembles closely that of *C. solidaginis* but the pycnial areas of the former are much brighter colored. The aecia differ quite widely in appearance. The difference in gross morphology between *C. delicatulum* and *C. solidaginis* is shown by the following table:

TABLE OF COMPARISON

Coleosporium delicatulum	*Coleosporium solidaginis*
Pycnia solitary or few, in one or two more or less extended rows, orange-chrome to English-red when fresh, on conspicuous, brightly-reddened spots.	*Pycnia* solitary or few, aggregated in one or two short rows, grenadine-red to mahogany-red when fresh, on inconspicuous, slightly-reddened spots.
Aecia inconspicuous, solitary or few, in one or two more or less extended rows.	*Aecia* conspicuous, solitary or few, aggregated in one to three short rows.
Peridia rupturing on the sides with recurved lacerate edges.	*Peridia* rupturing at the apex with irregular edges.

Coleosporium delicatulum, according to our records, has been collected in the United States as follows:

O and I on *Pinus*:

P. caribaea: Florida and Louisiana.

P. echinata: Maryland, Pennsylvania and South Carolina.

P. mayriana: District of Columbia.

P. nigra poiretiana Schneid: Pennsylvania.

P. palustris: Florida, Georgia, Mississippi and South Carolina.

P. resinosa: Vermont.

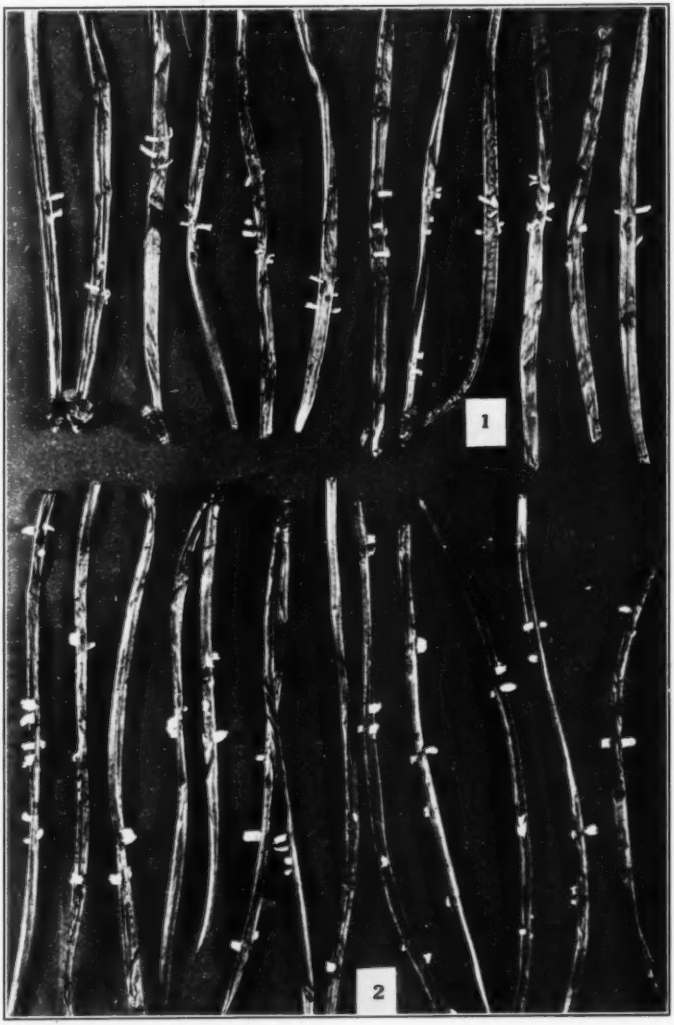
P. rigida: Connecticut, District of Columbia, Maryland, Massachusetts, New Jersey, New York, North Carolina and Pennsylvania.

P. serotina: Florida, Georgia, New Jersey and South Carolina.

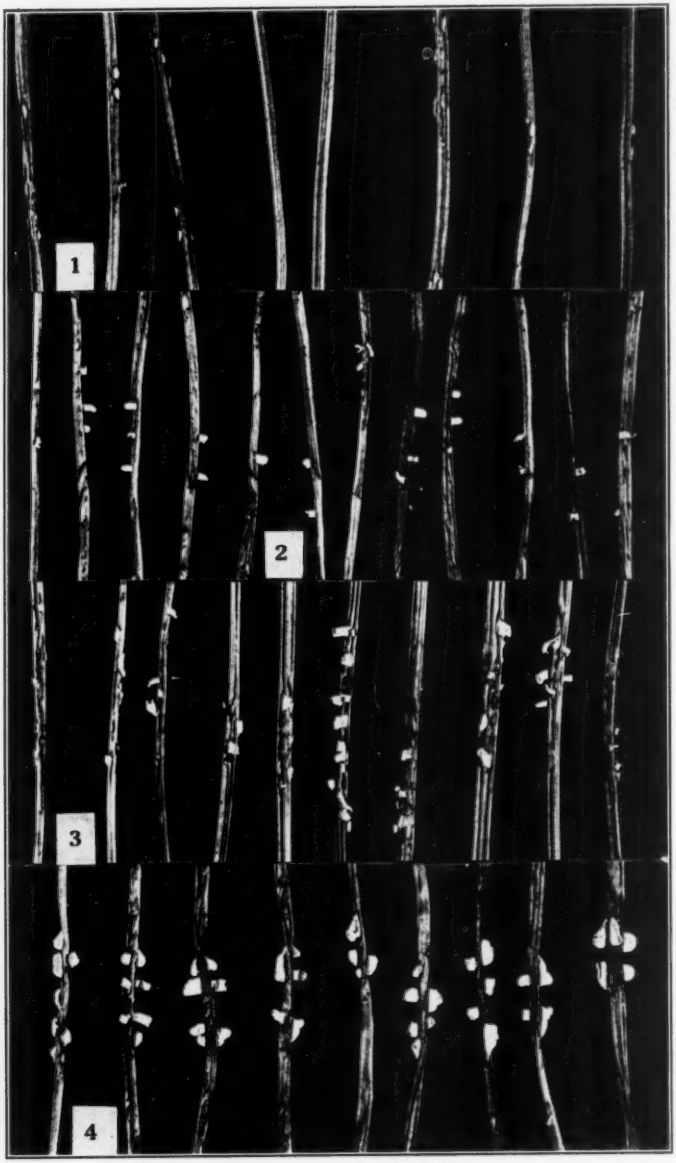
P. taeda: Florida, North Carolina, South Carolina, Virginia and Texas.

II and III on *Euthamia*:

E. caroliniana: Florida and New Jersey.



SPECIES OF COLEOSPORIUM



SPECIES OF COLEOSPORIUM

E. graminifolia: Connecticut, Delaware, District of Columbia, Illinois, Indiana, Kansas, Maryland, Massachusetts, Maine, Missouri, New Hampshire, New Jersey, North Carolina, New York, Pennsylvania, Rhode Island, Virginia and Vermont.

E. leptophylla: Louisiana and Texas.

Coleosporium delicatulum has been successfully inoculated on the following species: *Pinus caribaea, P. contorta, P. coulteri, P. echinata, P. glabra, P. mayriana, P. palustris, P. rigida, P. scopulorum, P. serotina, P. taeda, Euthamia caroliniana* and *E. graminifolia.*

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

EXPLANATION OF PLATES

PLATE 20

Fig. 1. The aecia of *Coleosporium inconspicuum* on the needles of *Pinus virginiana.* (× 2.)

Fig. 2. The aecia of *Coleosporium helianthi* on the needles of *Pinus virginiana.* (× 2.)

PLATE 21

Fig. 1. The aecia of *Coleosporium delicatulum* on the needles of *Pinus resinosa.* (× 2.)

Fig. 2. The aecia of *Coleosporium terebinthinaceae* on the needles of *Pinus echinata.* (× 2.)

Fig. 3. The aecia of *Coleosporium laciniariae* on the needles of *Pinus palustris.* (× 2.)

Fig. 4. The aecia of *Coleosporium solidaginis* on the needles of *Pinus echinata.* (× 2.)

DARK-SPORED AGARICS—IV

DECONICA, ATYLOSPORA, AND PSATHYRELLA

WILLIAM A. MURRILL

In previous articles of this series, the large, fleshy-stemmed species have been discussed. The present article deals with species having a slender, tubular stipe with cartilaginous cortex, and not furnished with an annulus. The three genera here treated may be distinguished as follows:

Lamellae decurrent.	*Deconica.*
Lamellae adnate or adnexed.	
Spores purplish-brown or dark-fuscous.	*Atylospora.*
Spores black.	*Psathyrella.*

DECONICA (W. G. Sm.) Sacc. Syll. Fung. **5**: 1058. 1887

Delitescor Earle, Bull. N. Y. Bot. Gard. **5**: 434. 1909.

This is a very small genus, separated from *Psilocybe* as a subgenus by W. G. Smith in 1870, because of its decurrent lamellae, and raised to generic rank by Saccardo in 1887. The attachment of the lamellae often varies to adnate or to adnate with a decurrent tooth. Two species, *D. bullacea* and *D. scatigena,* were discussed in my article on tropical agarics published in *Mycologia* for January, 1918.

Stipe 5–8 cm. long.	1. *D. coprophila.*
Stipe 1–5 cm. long.	
Pileus floccose or tomentose, not striate.	
Pileus floccose near and on the margin.	2. *D. rhomboidospora.*
Pileus tomentose over the entire surface.	3. *D. tomentosa.*
Pileus glabrous, usually striate.	
Pileus dry or hygrophanous, not viscid.	
Stipe 1–2.5 cm. long.	
Pileus not umbonate.	4. *D. bulbosa.*
Pileus umbonate.	5. *D. semistriata.*
Stipe 2.5–5 cm. long.	
Pileus not decidedly umbonate.	6. *D. polytrichophila.*
Pileus decidedly umbonate.	7. *D. pyrispora.*
Pileus viscid.	
Spores 7 × 5 μ.	8. *D. subviscida.*
Spores 12 × 9 μ.	9. *D. bullacea.*

1. DECONICA COPROPHILA (Bull.) Sacc. Syll. Fung. **5**: 1058. 1887

Agaricus coprophilus Bull. Herb. Fr. *pl. 566, f. 3;* hyponym. 1791; Pers. Syn. Fung. 412. 1801.

Pileus hemispheric to expanded, umbonate, 2–4 cm. broad; surface smooth, fulvous-isabelline; lamellae arcuate-subdecurrent, broad, livid-blackish; spores 13–14 x 8 μ; stipe attenuate upward, smooth, pallid, pruinose to glabrous above, glabrous and shining below, subfistulose, 5–8 cm. long, 2–3 mm. thick.

TYPE LOCALITY: France.

HABITAT: On manure or manured ground.

DISTRIBUTION: New York and Michigan; also in Europe.

ILLUSTRATIONS: Bull. Herb. Fr. *pl. 566, f. 3;* Cooke, Brit. Fungi. *pl. 608A (608A).*

There are several specimens bearing this name at Albany collected by Peck in New York, and also one collection sent by Kauffman from Michigan. The spores of Peck's plants are elongate-ellipsoid, smooth, isabelline under the microscope, about 12 x 6–7 μ.

2. DECONICA RHOMBOIDOSPORA Atk. Ann. Myc. **7**: 368. 1909

Pileus ovoid to convex, gregarious to subcespitose, 0.5–1 cm. broad; surface dry, smooth, not striate, ochraceous to clay-colored, adorned on and near the margin with whitish flocci; context ochraceous, with slightly mealy taste and no characteristic odor; lamellae adnate and decurrent, about 2 mm. broad, becoming chestnut-colored with whitish, dentate edges; spores ovoid to subrhomboid, smooth, purplish-brown, 5–7 x 4–5 μ; stipe flexuous, hollow, chestnut-colored within, clay-colored and whitish-fibrillose without, 2–3 cm. long, 2 mm. thick; veil evident when young, white, soon appendiculate.

TYPE LOCALITY: Ithaca, New York.

HABITAT: On leaves and decayed wood on the ground.

DISTRIBUTION: Known only from the type locality.

The type specimens, which I have not seen, were found by Jackson on June 5, 1904. According to Atkinson, it is near *D. nuciseda* Fries.

3. **Deconica tomentosa** sp. nov.

Pileus convex to nearly plane, not umbonate, solitary, about 1.5 cm. broad; surface dry, not at all striate, uniformly ochraceous-

ferruginous, clothed with a tufted, yellowish-brown tomentum that has a tendency to crack in areoles, reminding one of some species of *Inocybe,* margin incurved, entire, slightly paler; lamellae distinctly decurrent, distant, narrow, nearly white, becoming pale-purplish-brown, entire and scarcely paler on the edges, beautifully undulate in dried specimens; spores ellipsoid, rounded at both ends, smooth, pale-smoky-isabelline under the microscope, pale-purplish-brown in mass, 7–9 x 4–6 μ; stipe short, tapering downward, yellowish-white, clothed above with whitish tomentum and fibrils, about 1.5 cm. long, and 2 mm. thick.

TYPE LOCALITY: Auburn, Alabama.

HABITAT: On the ground.

DISTRIBUTION: Known only from the type locality.

Type collected by F. S. Earle on November 11, 1899.

4. DECONICA BULBOSA Peck, Ann. Rep. N. Y. State Mus. **46**: 107. 1893

Pileus submembranaceous, convex becoming nearly plane, 6–12 mm. broad; surface glabrous, slightly striate on the margin, whitish tinged with brown; lamellae broad, distant, adnate, purplish-brown; spores ellipsoid, purplish-brown, 7.5 x 5 μ; stipe slender, firm, hollow, bulbous, densely grayish-fibrillose, 1.5–2.5 cm. long, scarcely 1 mm. thick.

TYPE LOCALITY: Delmar, New York.

HABITAT: On dead stems of herbs.

DISTRIBUTION: Known only from the type locality.

The small type specimens are at Albany, collected by Peck in September.

5. DECONICA SEMISTRIATA Peck, Ann. Rep. N. Y. State Mus. **51**: 291. 1898

Pileus thin except on the prominent broadly-umbonate disk, 8–10 mm. broad; surface glabrous, somewhat wavy on the margin and striate to the umbo, grayish-brown, paler when dry and less distinctly striate, the broad umbo yellowish; lamellae broad, distant or subdistant, adnate or slightly decurrent, purplish-brown, whitish on the edges; spores compressed, suborbicular, 6.5–7.5 x 6.5 μ; stipe equal, firm, short, slightly floccose-fibrillose, stuffed with a whitish pith, colored like the pileus, 16–20 mm. long, 1 mm. thick.

TYPE LOCALITY: Gansevoort, New York.

HABITAT: On damp ground in woods.

DISTRIBUTION: Known only from the type locality.

Known only from two little plants collected by Peck in July and now attached to a sheet at Albany.

6. **Deconica polytrichophila** (Peck) comb. nov.

Agaricus polytrichophilus Peck, Ann. Rep. N. Y. State Mus. **30**: 42. 1878.

Psathyra polytrichophila Sacc. Syll. Fung. **5**: 1068. 1887.

Deconica bryophila Peck, Ann. Rep. N. Y. State Mus. **46**: 106. 1893.

Pileus thin, convex or subcampanulate, gregarious, 4–10 mm. broad; surface glabrous, sometimes with a slight umbo, hygrophanous, striatulate and brown when moist, dull-ochraceous or buff when dry, somewhat shining; context rather fragile, odorous; lamellae plane and adnate or slightly arcuate and decurrent, broad, subdistant, colored almost like the pileus; spores subellipsoid, purplish-brown, 8 x 5 μ; stipe slender, equal, subflexuous, slightly whitish-fibrillose, especially toward the base, mealy at the apex, concolorous, containing a whitish pith, 2.5–5 cm. long.

TYPE LOCALITY: West Albany, New York.

HABITAT: On the ground among *Polytrichum* or other mosses.

DISTRIBUTION: New York and Massachusetts.

Peck found this species twice in May. The type specimens are at Albany. I got specimens at Lake Placid (*156*) in July, 1912, growing on a sandy, mossy bank in woods, and described them as follows:

"Hemispheric, slightly striate-sulcate on the margin, 4–5 mm. broad, smooth, glabrous, isabelline at the center, umbrinous-isabelline otherwise, margin straight; lamellae plane, distant, adnate with a decurrent tooth, pale-ferruginous or about umbrinous; stipe pruinose at the apex, latericious, glabrous, filiform, tough, 3 cm. long, 0.5 mm. thick."

Deconica bryophila was described from specimens collected by Peck in May at Delmar and Karner. There are several collections at Albany from New York, and two from Massachusetts, collected by Mackintosh and Davis in April and June respectively.

7. **Deconica pyrispora** sp. nov.

Pileus convex to subexpanded, abruptly umbonate, solitary, about 1 cm. broad; surface glabrous, dry or slightly hygrophanous, avellaneous, striate to the umbo, which is smooth and isabelline,

margin straight, appressed in young stages; lamellae slightly decurrent, or adnate with a decurrent tooth, inserted, somewhat ventricose, of medium distance, rather uneven on the edges, becoming purplish-brown, not variegated; spores pear-shaped, tapering gradually at one end and abruptly at the other, smooth, pale-smoky-purplish-brown under the microscope, about 7 x 3.5–4.5 μ; stipe curved, equal, decidedly cartilaginous, glabrous, fibrillose toward the base, chestnut-colored, about 3.5 cm. long and 1.5 mm. thick.

TYPE LOCALITY: New York Botanical Garden, New York City.

HABITAT: In an old chestnut stump, growing on rotten wood and humus.

DISTRIBUTION: Known only from the type locality.

This interesting little species was found by me on August 29, 1911. It is characterized by a prominent nipple-like umbo and pear-shaped spores, which are purplish-black in mass. The affinities of the species are with *Atylospora;* but the lamellae are quite decurrent, and this character is seen to good advantage even in dried specimens.

8. DECONICA SUBVISCIDA Peck, Ann. Rep. N. Y. State Mus. 41: 70. 1888

Pileus thin, at first subconic, then convex or nearly plane, often slightly umbonate, gregarious, 6–12 mm. broad; surface glabrous, hygrophanous, pale-chestnut or reddish-tan-colored, subviscid and striatulate on the margin when moist, pallid or dull-buff when dry; lamellae broad, subdistant, adnate or slightly decurrent, at first whitish or dingy, then brownish-ferruginous; spores ellipsoid or ovoid, smooth, pale-ochraceous under the microscope, 7 x 5 μ; stipe equal or tapering downward, fibrillose, hollow, brownish toward the base, paler above, the fibrils whitish or grayish, 2.5 cm. long, 2 mm. thick; veil slight, white, evanescent.

TYPE LOCALITY: Menands, New York.

HABITAT: On horse manure and manured ground.

DISTRIBUTION: New York and Michigan.

Peck collected the type specimens in August. He says it appears in wet weather in great abundance and in successive crops. Kauffman reports it from Michigan, growing in the open on manure and in the woods on moss. Both Peck and Kauffman consider it very nearly related to *D. bullacea,* which is true if the general appear-

ance alone is considered, but the lamellae and spores are totally distinct.

9. DECONICA BULLACEA (Bull.) Sacc. Syll. Fung. **5**: 1058. 1887

Agaricus bullaceus Bull. Herb. Fr. *pl. 566, f. 2;* hyponym. 1791; Pers. Syn. Fung. 412. 1801.

Pileus convex-hemispheric, sometimes umbonate, gregarious, 0.5–2 cm. broad; surface glabrous, viscid, smooth, slightly striate at times, bay-brown when fresh and moist, paler with age or on drying; context brownish-pallid, mild; lamellae adnate-decurrent, plane, very broad, triangular, subdistant, dark-purplish-brown at maturity with whitish edges; spores broadly-ellipsoid to ovoid, usually tapering at both ends, apiculate, smooth, varying from ochraceous to dull-ferruginous or darker under the microscope, purplish-brown in mass, 10–12 x 8–9 μ; stipe cylindric, equal, pale-brownish, subfibrillose, solid or stuffed, 3–5 cm. long, 1–2 mm. thick; veil slight, evanescent.

TYPE LOCALITY: France.

HABITAT: Usually on horse manure in pastures and along roads.

DISTRIBUTION: Eastern United States, south to Mississippi, and west to Michigan; also in Europe; abundant in tropical America.

ILLUSTRATIONS: Bull. Herb. Fr. *pl. 566, f. 2;* Cooke, Brit. Fungi *pl. 608 B (600 B)*; Pat. Tab. Fung. *f. 235.*

This species was first figured by Bulliard from specimens collected in France. While probably widely distributed, it has not often been reported from this country. The spores of excellent specimens collected in Jamaica are ovoid, smooth, opaque, umbrinous by transmitted light under the microscope, 11–12 x 6–8 μ. They are darker than spores from specimens found in New York City.

DOUBTFUL SPECIES

Deconica atrorufa (Fries) Sacc. Syll. Fung. **5**: 1059. 1887. (*Agaricus atrorufus* Fries, Syst. Myc. **1**: 293. 1821.) Dr. Kauffman reports this species (as *Psilocybe*) from more than one locality in Michigan, growing gregariously on the ground in woods. His spore measurements agree with those made by Karsten, being 5–8 x 4–5.5 μ. Fries got his name from Schaeffer, but some think he wrongly interpreted Schaeffer's plant.

ATYLOSPORA Fayod, Ann. Sci. Nat. VII. **9**: 376. 1889

Psathyra Quél. Champ. Jura Vosg. 118. 1872; not *Psathyra* Spreng. 1818; not *Psathura* Commers. 1789.

This rather difficult genus, well represented both in temperate and tropical regions, is characterized by a cartilaginous stipe, a straight margin appressed when young, and the absence of a veil. It is difficult to distinguish in the herbarium from *Psilocybe* and *Drosophila*. *Psathyrella* differs in having black spores, but even here it is at times hard to draw the line. The species are mostly overlooked or given scant attention by collectors because generally inconspicuous and rather poorly known. In *Mycologia* for January, 1918, I discussed the 21 tropical American species, 11 of which were there described as new. None of our northern forms appear to grow under tropical conditions.

Stipe 2–4 cm. long.
  Densely cespitose. — 1. *A. microsperma.*
  Not densely cespitose. — 2. *A. vestita.*
Stipe 5–10 cm. long.
  Densely cespitose. — 3. *A. multipedata.*
  Not densely cespitose.
    Stipe 1 mm. thick. — 4. *A. prunuliformis.*
    Stipe 2–3 mm. thick.
      Pileus pale-fawn-colored. — 5. *A. australis.*
      Pileus purplish-brown. — 6. *A. umbonata.*
    Stipe 3–5 mm. thick. — 7. *A. striatula.*

1. **Atylospora microsperma** (Peck) comb. nov.

Psathyra microsperma Peck, Bull. Torrey Club **26**: 68. 1899.

Pileus ovoid or subhemispheric, becoming deeply convex or subcampanulate, obtuse, densely cespitose, 1–2.5 cm. broad; surface even, hygrophanous, brown when moist, paler when dry, slightly floccose when young; context brownish; lamellae thin, crowded, adnate-seceding, white to purplish-brown, whitish on the edges; spores smooth, ellipsoid, purplish-brown, about 7 x 4 μ; stipe equal, rigid-fragile, hollow, pure-white, fibrillose, 2.5–4 cm. long, 2–3 mm. thick.

TYPE LOCALITY: Ohio.

HABITAT: About old stumps.

DISTRIBUTION: Ohio and Michigan.

The type specimens collected by Lloyd (*3480*) in April are fairly well preserved at Albany. Kauffman says it occurs rarely in Michigan, having been found by him (*365*) growing in turf at Ann Arbor, in October, 1905. Some of his specimens determined by Peck are at Albany. They are thinner and more slender than the types.

2. **Atylospora vestita** (Peck) comb. nov.

Psathyra vestita Peck, Bull. N. Y. State Mus. 105: 28. 1906.

Pileus thin, submembranaceous, ovoid, conic or subcampanulate, obtuse, 8–16 mm. broad; surface at first covered with white, floccose fibrils, usually with a rufescent tint, soon paler or white and silky-fibrillose, sometimes slightly striate on the margin; lamellae thin, narrow, close, adnate, white when young, becoming blackish-brown; spores ellipsoid, purplish-brown, 7.5–10 x 5–6 μ; stipe equal, hollow, flexuous, white, floccose-fibrillose, becoming silky-fibrillose, mealy and often striate at the apex, 2.5–4 cm. long, 2–3 mm. thick.

TYPE LOCALITY: North Elba, New York.

HABITAT: On fallen leaves and grass.

DISTRIBUTION: Known only from the type locality.

Type specimens collected by Peck in September, 1905, are well preserved at Albany, appearing much like a small form of *Drosophila appendiculata*. Kauffman recognized *P. semivestita* as occurring in Michigan and remarks that *P. vestita* is "*very similar*, if not the same, but the spore-sizes are given somewhat smaller."

3. **Atylospora multipedata** (Peck) comb. nov.

Psathyra multipedata Peck, Bull. Torrey Club **32**: 80. 1905.

Pileus submembranaceous, conic or hemispheric, densely cespitose, forming tufts of many individuals, 12–16 mm. broad; surface glabrous, hygrophanous, light-bay or tawny when moist, cinereous when the moisture has escaped, the center retaining its moisture longer than the margin; lamellae thin, close, adnate, pallid or gray becoming brown, whitish on the edges; spores brown, ellipsoid, 6–8 x 4–5 μ; stipe slender, equal, hollow, brittle, furfuraceous, becoming smooth or sometimes remaining fibrillose near the base, pure-white, 5–10 cm. long, 2 mm. thick.

TYPE LOCALITY: St. Louis, Missouri.

HABITAT: In grassy ground.

DISTRIBUTION: Vicinity of St. Louis, Missouri.

Excellent type specimens are at Albany, collected at one spot by N. M. Glatfelter (*787*) in September and October, 1900, 1902, and 1903. He made good notes on the fresh specimens and sent them to Peck. I have a fine cluster sent me by Dr. Lewis Sherman (*35*), who collected it at Milwaukee, Wisconsin, in October, 1914.

4. **Atylospora prunuliformis** sp. nov.

Pileus thin, subfleshy, convex, obtuse, gregarious to subcespitose, 1 cm. broad; surface dry, glabrous, rugose, pale-fawn-colored or light-tan-colored, margin concolorous, substriate; context thin, pale-tawny, the taste mild; lamellae adnate, broad, subdistant, subventricose, white; spores ellipsoid, sometimes ovoid, smooth, dark-bay under the microscope, about 12 x 6 μ; stipe cylindric, very slender, glabrous, concolorous, paler and brownish at the apex, hollow, whitish-mycelioid at the base, 5 cm. long, 1 mm. thick.

TYPE LOCALITY: New York Botanical Garden, New York City.

HABITAT: In sandy soil in mixed woods.

DISTRIBUTION: Known only from the type locality.

Type collected by F. S. Earle (*89*) on June 22, 1902. This species much resembles *Prunulus*, both in a fresh and dried condition.

5. **Atylospora australis** sp. nov.

Pileus fragile, expanded, subumbonate, gregarious to cespitose, 1–3 cm. broad; surface glabrous, hygrophanous, slightly striate, pale-fawn-colored, slightly darker on the disk; lamellae adnexed, crowded, rather narrow, concolorous, then brownish; spores ellipsoid, smooth, opaque, purplish-brown under the microscope, about 8–9 x 5 μ; stipe rigid-fragile, cylindric or slightly tapering above, glabrous or somewhat atomaceous, hollow, pure-white, 4–6 cm. long, 2–3 mm. thick; veil slight, soon vanishing, white.

TYPE LOCALITY: City Park, New Orleans, Louisiana.

HABITAT: On rotten wood or humus.

DISTRIBUTION: Vicinity of New Orleans.

Type collected by F. S. Earle (*27*) on September 3, 1908. Said to be common at the time. Also by Earle (*117*, *118*) at Chalmitte, New Orleans, September 8, 1908.

6. **Atylospora umbonata** (Peck) comb. nov.

Psathyra umbonata Peck, Ann. Rep. N. Y. State Mus. **50**: 106. 1897.

Pileus submembranaceous, campanulate, umbonate, gregarious to cespitose, 2–5 cm. broad; surface hygrophanous, purplish-brown and striatulate when moist, grayish-white when dry, smooth or slightly rugulose, atomate, the umbo commonly paler; context concolorous; lamellae rather broad, moderately crowded, ventricose, subadnate, brownish-red, becoming purplish-brown and finally almost black, whitish on the edges; spores ellipsoid, smooth, purplish-brown under the microscope, blackish-brown to almost black in mass, 12–15 x 7–8 μ; stipe slender, flexuous, rigid-fragile, equal, hollow, white to pallid, slightly mealy at the apex, 5–10 cm. long, 2–3 mm. thick.

TYPE LOCALITY: Lake Pleasant, New York.

HABITAT: On chip dirt.

DISTRIBUTION: New York, Michigan, Missouri, and Washington.

ILLUSTRATION: Kauffm. Agar. Mich. *pl. 56.*

The type specimens, collected by Peck in July, are well preserved at Albany; and specimens sent to Peck from Missouri by Glatfelter appear to match the types. Kauffman reports it as rather frequent in Michigan and gives interesting notes as well as figures of it. I found it at Seattle, Washington, in the autumn of 1911 (*628*), growing in decaying trash in moist woods. This species is probably too near *Atylospora corrugis.* See doubtful species.

7. **Atylospora striatula** sp. nov.

Pileus thin, fragile, conic-campanulate to expanded, subumbonate, sometimes with a small umbilicus, scattered, 2–4 cm. broad; surface dry, glabrous, conspicuously long-striate, dull-bay to isabelline; context thin, brownish, with mild taste; lamellae adnexed, crowded, plane or ventricose, rather narrow, white or isabelline to purplish-brown; spores ellipsoid, smooth, pale-purplish-brown under the microscope, purplish-brown in mass, about 7 x 4 μ; stipe rigid-fragile, equal, smooth, shining-white, hollow, 5–7 cm. long, 3–5 mm. thick.

TYPE LOCALITY: New York Botanical Garden, New York City.

HABITAT: On humus in shaded places.

DISTRIBUTION: Connecticut and New York.

Type collected by W. A. Murrill, July 3, 1915, on leaf-mold in rhododendron beds. Miss Eaton made a colored sketch at that time. Also collected by F. S. Earle at Redding, Connecticut, July 22, 1902 (*614*); at West Park, New York, August 7 and 8, 1903 (*1776, 1811*); and in the New York Botanical Garden, June 16, 1902 (*108*).

DOUBTFUL AND EXCLUDED SPECIES

Agaricus (*Psathyra*) *pholidotus* Mont. Syll. Crypt. 126. 1856. Collected in grassy ground at Columbus, Ohio, by Sullivant. Described as fugacious with scaly disk, reminding one of some species of *Coprinus*, but the gills are blackish-purple. I have not seen the types.

Atylospora corrugis (Pers.) Fayod, Ann. Sci. Nat. VII. **9**: 376. 1889. Specimens from Bresadola greatly resemble the types of *A. umbonata*, but Peck says his species is much darker, striatulate, and atomate, with a less glabrous and more slender stipe and broader spores; also the umbo is very prominent and becomes white on drying.

Psathyra obtusata Fries, Syst. Myc. **1**: 293. 1821. Reported by Kauffman from Michigan, occurring infrequently on very rotten wood. I have not seen his specimens.

Psathyra persimplex Britz. Bot. Centralb. **77**: 436. 1899. Reported by Kauffman as rare on dead wood in hemlock woods in Michigan. He says it differs from *P. obtusata* in the size of its spores and the characteristic spreading of the margin of the pileus.

Psathyra polytrichophila (Peck) Sacc. See *Deconica*.

Psathyra roseolus (Clements) Sacc. Syll. Fung. **14**: 154. 1899. (*Gymnochilus roseolus* Clements, Bot. Surv. Neb. **4**: 23. 1896.) Collected on the ground on bluffs of the Missouri River, at Bellevue, Nebraska. Pileus hemispheric or convex, 1–2.5 cm. broad, glabrous or nearly so, wrinkled, vinous when wet, incarnate when dry; lamellae slightly remote, purplish-cinnamon-colored; spores ellipsoid, dark-purple, 12–13 x 7–8 μ; stipe tall, fragile, fistulose, shining, glabrous, farinaceous-granular at the apex, 4–8 cm. long, 2 mm. thick. I have not seen the types.

Psathyra semivestita (Berk. & Br.) Sacc. Syll. Fung. **5**: 1071. 1887. (*Agaricus semivestitus* Berk. & Br. Ann. Mag. Nat. Hist. III. **7**: 376. 1861.) Described from England and reported by Kauffman from Michigan, growing gregariously on horse manure. He says Peck's *P. vestita* is *very similar*, and Peck says his species differs in color and in being wholly clothed when young with white, floccose fibrils.

Psathyra silvatica Peck, Ann. Rep. N. Y. State Mus. **42**: 116. 1889. The types from North Elba are attached to a sheet at Albany and marked in Peck's handwriting "equal *Tubaria silvatica* Peck." The species is omitted from Peck's later account of the New York species of *Psathyra*.

PSATHYRELLA (Fries) Quél. Champ. Jura Vosg. 122. 1872

Agaricus § *Psathyrella* Fries, Epicr. Myc. 237. 1838.

Characterized by black spores and a straight, appressed margin when young. It is best known, perhaps, through its interesting little representative, *Psathyrella minutula*, which is widely distributed. In *Mycologia* for January, 1918, the six species known from tropical North America were discussed, five of them being there described as new.

Stipe 1–5 cm. long.
- Pileus white or gray, furfuraceous; hymenophores densely gregarious or cespitose. 1. *P. minutula.*
- Pileus bluish-white, changing to sepia-brown on drying except at the apex. 2. *P. leucostigma.*
- Pileus reddish-cinereous, becoming paler on drying; stipe scarcely 1 mm. thick. 3. *P. tenera.*
- Pileus some shade of brown.
  - Pileus 2–4 mm. broad. 4. *P. minima.*
  - Pileus 8–12 mm. broad; decorated with erect hairs. 5. *P. hirta.*
  - Pileus 1–3 cm. broad.
    - Stipe 3–4 mm. thick. 6. *P. castaneicolor.*
    - Stipe 1–2 mm. thick.
      - Stipe white, glabrous. 7. *P. betulina.*
      - Stipe pale-brown, fibrillose. 8. *P. Bartholomaei.*

Stipe 5–15 cm. long.
- Pileus bluish-white, with yellow disk. 9. *P. gracillima.*
- Pileus whitish, becoming grayish. 10. *P. debilis.*

Pileus grayish-black.	
Surface deeply radiate-sulcate.	11. *P. Clementsii.*
Surface smooth, not sulcate.	12. *P. angusticeps.*
Pileus some shade of brown, yellowish-brown, or reddish-brown.	
Stipe 1–2 mm. thick.	
Stipe white.	13. *P. atomata.*
Stipe reddish-fulvous.	14. *P. petasiformis.*
Stipe 2–4 mm. thick.	
Stipe 5–8 cm. long.	
Lamellae crowded.	15. *P. odorata.*
Lamellae distant.	16. *P. distantifolia.*
Stipe 10–13 cm. long.	17. *P. graciloides.*

1. PSATHYRELLA MINUTULA (Schaeff.) Murrill, Mycologia **10**: 26. 1918

Agaricus minutulus Schaeff. Fung. Bavar. Ind. 72. 1774.
Agaricus disseminatus Pers. Syn. Fung. 403. 1801.
Psathyrella disseminata Quél. Champ. Jura Vosg. 123. 1872.

Pileus membranaceous, ovoid-campanulate, densely gregarious or cespitose, 6–10 mm. broad; surface minutely scaly, becoming smooth, whitish, gray, or grayish-brown, often buff on the umbo, margin sulcate-plicate; context very thin, with mild taste and no odor; lamellae adnate, broad, subdistant, ventricose, white to gray, then black; spores ellipsoid, tapering at both ends, smooth, dark-purplish-brown in mass, chestnut-bay under the microscope, 8–9 x 4 μ; stipe furfuraceous to glabrous, white or yellowish to cinereous, very slender, becoming hollow, often curved, about 2.5 cm. long and 1 mm. thick.

TYPE LOCALITY: Bavaria.

HABITAT: On decayed wood and moist earth containing organic matter.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Atk. Stud. Am. Fungi, *f. 49;* Boud. Ic. Myc. *pl. 140;* Gill. Champ. Fr. *pl. 141 (586);* Hard, Mushr. *f. 280;* Mycologia **6**: *pl. 132, f. 1;* Pat. Tab. Fung. *f. 351;* Schaeff. Fung. Bavar. *pl. 308;* Bull. U. S. Dept. Agr. 175: *pl. 29, f. 2.*

This very attractive little species was first described from Bavaria and accurately figured in color by Schaeffer. The synonymy is considerably complicated but it seems quite certain that the specific name under which the plant is best known has been in use

since 1801, when Persoon extended his former use of this name to include the juvenile form as figured by Schaeffer in his plate 308. The plant is widely distributed and very abundant, often occurring in one spot in such large numbers that it is practically impossible to count the dainty little caps. It may be looked for throughout the season from early summer until late autumn and often appears on the soil in greenhouses during the winter. The species strongly suggests *Coprinus*, both in its mode of expanding and in blackening with age, when the black spores are mature. The microscopic structure of the hymenium is also similar to that of *Coprinus;* and Lange has transferred it to that genus. Buller, however, criticizes him for so doing and advances several good reasons why it should remain in *Psathyrella.*

2. PSATHYRELLA LEUCOSTIGMA Peck, Bull. Torrey Club **22**: 490. 1895

Pileus submembranaceous, campanulate, 8–12 mm. broad; surface striate, bluish-white when fresh, changing to sepia-brown when dried, the apex remaining whitish; lamellae crowded, lead-colored when young, becoming black with age, whitish on the edges; spores ellipsoid, black, 12.5–15 x 7.5 μ; stipe slender, flexuous, hollow, white, 2.5–4 cm. long, about 2 mm. thick.

TYPE LOCALITY: Kansas.

HABITAT: On wet ground under trees.

DISTRIBUTION: Known only from the type locality.

The type specimens, collected by Bartholomew in July, do not appear to be either at Albany or in the Ellis Collection.

3. PSATHYRELLA TENERA Peck, Ann. Rep. N. Y. State Mus. **47**: 144. 1894

Pileus thin, campanulate, obtuse, 6–10 mm. broad; surface moist or subhygrophanous, reddish-cinereous when moist, paler when dry, slightly rugulose and atomate; lamellae broad, adnate, plane or but slightly ascending, subdistant, at first pallid or subcinereous, then umber and finally blackish, white on the edges; spores narrowly ellipsoid, 12–16 x 8–10 μ; stipe slender, glabrous, stuffed or hollow, white, with a white, floccose mycelium at the base, 2.5–4 cm. long, scarcely 1 mm. thick.

TYPE LOCALITY: Pierrepont Manor, Jefferson County, New York.

HABITAT: On damp mucky ground in open woods.

DISTRIBUTION: Known only from the type locality.

The type specimens, collected by Peck in June, are well preserved at Albany, and seem very near plants called *P. atomata* Fries by Bresadola. Specimens from Westport so named appear to be distinct.

4. PSATHYRELLA MINIMA Peck, Ann. Rep. N. Y. State Mus. **41**: 70. 1888

Pileus membranaceous, hemispheric, obtuse, 2–4 mm. broad; surface obscurely striatulate when moist, even and pruinose-atomate when dry, dingy-yellow or reddish-brown, becoming paler on drying; lamellae broad, adnate, white, becoming yellowish-cinnamon; spores narrowly ellipsoid, black, 6–8 x 3–4 μ; stipe capillary, minutely mealy or furfuraceous under the lens, pellucid, white, 8–12 mm. long.

TYPE LOCALITY: Adirondack Mountains, New York.

HABITAT: On manure in woods.

DISTRIBUTION: Known only from the type locality.

This tiny species is represented only by a few specimens collected by Peck in July and now attached to a sheet at Albany.

5. PSATHYRELLA HIRTA Peck, Ann. Rep. N. Y. State Mus. **50**: 107. 1897

Pileus thin, hemispheric, subcespitose, 8–12 mm. broad; surface hygrophanous, at first covered with erect, fascicled hairs, reddish-brown when moist, grayish-brown or whitish when dry; lamellae adnate or subdecurrent, subcrowded, broad, pallid to black; spores 12–14 x 6–7 μ; stipe flexuous, shining, white, hollow, squamose, 2.5–5 cm. long, 2–3 mm. thick.

TYPE LOCALITY: Minerva, New York.

HABITAT: On manured, shaded ground.

DISTRIBUTION: Known only from the type locality.

The type specimens collected by Peck are attached to a sheet at Albany. Others so named collected by Kellerman in October, 1906, in a greenhouse at Columbus, Ohio, appear to agree with the type of *P. Bartholomaei.*

6. **Psathyrella castaneicolor** sp. nov.

Pileus fleshy, hemispheric to expanded, 3 cm. broad; surface

hygrophanous, glabrous, sometimes having fragments of the white veil when very young, chestnut to tan, margin even, splitting; context thin, brownish, with mild but mawkish taste; lamellae sinuate-adnate, subcrowded, broad, plane, white to purplish, then black; spores ellipsoid or ovoid, smooth, opaque, sometimes apiculate, very dark-bay under the microscope, about 12 x 7 μ; stipe subcylindric, subglabrous, floccose above, hollow, white, 4 cm. long, 3–4 mm. thick.

TYPE LOCALITY: Redding, Connecticut.

HABITAT: On a pile of decaying leaves.

DISTRIBUTION: Known only from the type locality.

Type collected by F. S. Earle (*381*) on July 17, 1902.

7. PSATHYRELLA BETULINA Peck, Bull. Torrey Club **34**: 101. 1907

Pileus thin, submembranaceous, fragile, conic or convex, sometimes broadly umbonate, 1–2.5 cm. broad; surface glabrous, atomate, hygrophanous, fuscous or dark-brown when moist, paler when dry; lamellae broad, adnate, subdistant, cinereous, becoming black, white on the edges; spores ellipsoid, black, 8–10 x 5–6 μ; stipe fragile, equal, hollow, glabrous, shining, white, 2.5–5 cm. long, 1–2 mm. thick.

TYPE LOCALITY: Stow, Massachusetts.

HABITAT: On decaying branches of white birch.

DISTRIBUTION: Known only from the type locality.

The type specimens are at Albany, collected by Simon Davis on September 26, 1906. They resemble species of *Atylospora,* but the spores are black.

8. PSATHYRELLA BARTHOLOMAEI Peck, Bull. Torrey Club **22**: 490. 1895

Pileus thin, subconic or convex, 1.5–3 cm. broad; surface glabrous, striate on the margin, pale-brown; lamellae crowded, nearly plane, adnate, brownish, becoming black; spores ellipsoid, 10–13 x 5–6.5 μ; stipe slender, flexuous, hollow, adorned with a few grayish fibrils, pale-brown, 2.5–4 cm. long, scarcely 2 mm. thick.

TYPE LOCALITY: Rockport, Kansas.

HABITAT: On wet ground in woods; also in greenhouses.

DISTRIBUTION: Ohio and Kansas.

ILLUSTRATION: Hard, Mushr. *f. 281.*

The type specimens were collected by Bartholomew (*1838*) on July 28, 1895, and are in the Ellis Collection here. The Ohio plants were collected by Kellerman in October in a greenhouse at Columbus.

9. PSATHYRELLA GRACILLIMA Peck, Bull. Torrey Club **23**: 417. 1896

Pileus membranaceous, convex or nearly plane, 1.5–4 cm. broad; surface finely striate nearly to the disk, subhyaline, bluish-white with a pinkish tint, the disk yellow and commonly depressed; lamellae thin, crowded, rounded behind and adnexed or nearly free, light-slate-colored when young, becoming black or variegated with black; spores oblong-ellipsoid, pointed at one end, 13.5–15 x 6–7.5 μ; stipe slender, elongate, erect, hollow, whitish or cream-colored, 7.5–12.5 cm. long, about 2 mm. thick.

TYPE LOCALITY: Rooks County, Kansas.

HABITAT: On damp ground among weeds.

DISTRIBUTION: Pennsylvania and Kansas.

The type specimens sent to Peck by Bartholomew (*2201*) were collected on July 20, 1896. They resemble *Coprinus Sprague*i, but are larger. I found the species at Ohio Pyle, Pennsylvania, in July, 1905.

10. PSATHYRELLA DEBILIS Peck, Bull. Torrey Club **23**: 418. 1896

Pileus membranaceous, campanulate, umbonate, 1.5–3.5 cm. broad; surface striate nearly to the umbo, subhyaline, whitish, becoming grayish; lamellae adnate, thin, narrow, crowded, whitish when young, becoming black; spores broadly ellipsoid, 13 x 8 μ; stipe slender, weak, flexuous, white, hollow, never erect, 5–8 cm. long, 2–3.5 mm. thick.

TYPE LOCALITY: Rooks County, Kansas.

HABITAT: On damp ground, attached to decaying stems.

DISTRIBUTION: Known only from the type locality.

Collected by Bartholomew (*2199*) on July 20, 1896. A part of the type collection is at Albany and a part in the Ellis Collection here. According to Peck, the species suggests *Psathyra gyroflexa*, but differs in the umbonate pileus, the larger spores, and in having no purplish tint to the lamellae.

11. PSATHYRELLA CLEMENTSII Sacc. Syll. Fung. **14**: 163. 1899
Psathyrella sulcata Clements, Bot. Surv. Neb. **3**: 13. 1894. Not *P. sulcata* (Dunal) Sacc. 1887.

Pileus campanulate to expanded, 1–2.5 cm. broad; surface deeply radiate-sulcate, grayish-black, light-yellow on the umbo, pellucid; lamellae adnexed, subventricose, cinereous, black on the edges; spores ovoid-apiculate, purplish-brown, 8–10 x 5–6 μ; stipe slender, hollow, shining, white above, red below, 4–6 cm. long, 1–2 mm. thick.

TYPE LOCALITY: Lincoln, Nebraska.

HABITAT: On the ground.

DISTRIBUTION: Known only from the type locality.

The type specimens were collected by Clements. I have not seen them.

12. PSATHYRELLA ANGUSTICEPS Peck, Bull. Torrey Club **33**: 217. 1906

Pileus very thin, membranaceous, conic or subcampanulate, subacute, often with a small but prominent umbo, gregarious, 1–2 cm. broad; surface hygrophanous, fragile, minutely flocculose, appendiculate with minute fragments of the whitish veil, sometimes striate on the margin, grayish-brown, whitish or grayish on the margin; lamellae ascending, thin, brittle, moderately crowded, adnate, pale-olive-green becoming darker and finally black; spores broadly-ellipsoid, black, abruptly-narrowed at the ends, 15–20 x 10–12 μ; stipe very long, slender, fibrous, rather tough, hollow, straight or nearly so, ashy-gray above, chestnut-colored below, sometimes slightly thicker toward the base, 5–9 cm. long, about 1 mm. thick.

TYPE LOCALITY: Falmouth, Massachusetts.

HABITAT: On grassy ground.

DISTRIBUTION: Known only from the type locality.

The type specimens, which are well preserved at Albany, were collected by Simon Davis on June 22, 1905. They resemble a narrow, unexpanded form of *Panaeolus campanulatus*.

13. PSATHYRELLA ATOMATA (Fries) Quél. Champ. Jura Vosg. 123. 1872

Agaricus atomatus Fries, Syst. Myc. **1**: 298. 1821.

Pileus bell-shaped, obtuse, solitary or gregarious, 1–2.5 cm. broad; surface atomaceous, hygrophanous, livid, tan or pale-flesh-colored when dry; margin slightly striate, dry, even or wrinkled; lamellae adnate, subdistant, broad, ventricose, whitish to blackish; spores ovoid to ellipsoid, 13–15 x 6–8 μ; stipe equal, lax, slightly

bent, not rooting, pulverulent at the apex, tubular, white, 5 cm. long, 2 mm. thick.

TYPE LOCALITY: Europe.

HABITAT: On grassy ground along paths.

DISTRIBUTION: Northeastern United States; also in Europe.

ILLUSTRATIONS: G. Bernard, Champ. Rochelle *pl. 25, f. 5;* Cooke, Brit. Fungi *pl. 642 (638)*; Pat. Tab. Fung. *f. 236;* Saunders, Smith & Bennett, Myc. Illust. *pl. 37, f. 2.*

Described from Sweden, and reported from several parts of the United States by Ellis, Kellerman, Johnson, Bundy, and others. I have specimens from Paris and London, collected by myself, which agree with New York specimens collected by O. F. Cook. Peck's plants from West Albany so named are mounted and figured on a sheet with *P. graciloides,* which they much resemble.

14. **Psathyrella petasiformis** sp. nov.

Pileus conic to campanulate with conic umbo, becoming subexpanded with upturned edges, gregarious, reaching 2 cm. broad and about 1 cm. high; surface glabrous, hygrophanous, striatulate to the disk, fulvous with a reddish tint, fading to yellow except on the disk, margin thin, yellowish, slightly projecting; context very thin; lamellae adnate, crowded, inserted, grayish-olive to nearly black, whitish on the edges; spores oblong-ellipsoid, tapering at both ends, smooth, smoky-purplish-brown under the microscope, 8–10 x 4.5–5.5 μ; stipe cartilaginous, slightly fibrillose-scaly, fulvous with a reddish tint, hollow, about 5 cm. long and 1–2 mm. thick.

TYPE LOCALITY: Buck Hill Falls, Pennsylvania.

HABITAT: On much-decayed wood in woods.

DISTRIBUTION: Known only from the type locality.

Collected on August 28, 1921, by Mrs. John R. Delafield, who made good notes and a colored sketch from the fresh specimens. The specific name selected was suggested by the hat-shaped pileus.

15. PSATHYRELLA ODORATA (Peck) Sacc. Syll. Fung. **5**: 1136. 1887

Agaricus odoratus Peck, Ann. Rep. N. Y. State Mus. **24**: 70. 1872.

Pileus thin, fragile, ovoid-convex, at length expanded, gregarious or subcespitose, 2.5–5 cm. broad; surface smooth, hygrophanous, dark-reddish-brown and striatulate on the margin when

moist, dirty-white or clay-colored with a pinkish tint, subatomaceous and radiately-rugose when dry; context having a strong odor resembling that of *Sambucus pubens;* lamellae crowded, broad, attached, with a slight spurious decurrent tooth, dingy-flesh-colored, then rosy-brown, finally black with whitish edges; spores ellipsoid-cymbiform, 9 μ long; stipe pallid, equal, hollow, slightly enlarged at the base, slightly mealy and striate at the apex, subfibrillose when young, 5–8 cm. long, 2–4 mm. thick.

TYPE LOCALITY: West Albany, New York.

HABITAT: About manure heaps.

DISTRIBUTION: Known only from the type locality.

The type specimens at Albany, collected by Peck in May, are attached to a sheet and fairly well preserved. He seems to have found it in quantity. *Psilocybe atomatoides* seems very close.

16. **Psathyrella distantifolia** sp. nov.

Pileus convex to expanded, becoming slightly depressed at the center at times, solitary, about 3 cm. broad; surface dry or slightly hygrophanous, glabrous, conspicuously striate, dark-isabelline to fuliginous; lamellae adnate or sinuate, broad, distant, becoming dark-fumosus to almost ater, whitish on the edges; spores narrowly-ellipsoid, sometimes apiculate, smooth, opaque, dark-bay under the microscope, about 10 x 5 μ; stipe slender, equal, smooth, white, glabrous, hollow, about 7 cm. long, 2–3 mm. thick.

TYPE LOCALITY: Bronx Park, New York City.

HABITAT: On loam in woods.

DISTRIBUTION: Known only from the type locality.

The type specimens were collected by myself on September 10, 1911, and a photograph taken of them. This species is rather near *Psilocybe atomatoides* but the gills are more distant and the spores larger and darker.

17. PSATHYRELLA GRACILOIDES (Peck) Sacc. Syll. Fung. **5**: 1127. 1887

Agaricus graciloides Peck, Ann. Rep. N. Y. State Mus. **30**: 42. 1878.

Pileus thin, conic or campanulate, gregarious, 2.5 cm. broad; surface glabrous, hygrophanous, brown and striatulate when moist, whitish and subrugulose when dry; lamellae ascending, rather broad, subdistant, brown, becoming blackish-brown, whitish on the edges; spores ellipsoid, blackish, 12–16 x 8–10 μ; stipe long,

straight, fragile, hollow, smooth, white, 10–13 cm. long, 2–4 mm. thick.

TYPE LOCALITY: Maryland, New York.

HABITAT: On the ground in an old dooryard.

DISTRIBUTION: New York.

ILLUSTRATION: Ann. Rep. N. Y. State Mus. **30**: *pl. 1, f. 1–4.*

Type specimens were collected by Peck in September. Figured specimens attached to a sheet are from Knowersville and were called "*P. gracilis* Fr." Half a dozen other collections from New York appear to match the type. *P. debilis* does not seem very distinct.

DOUBTFUL SPECIES

Psathyrella crenata (Lasch) Fries, Hymen. Eur. 315. 1874. Kauffman refers a Michigan plant to this species, citing differences, and adding that it agrees well with Cooke's figure.

Psathyrella falcifolia (Mont.) Sacc. Syll. Fung. **5**: 1134. 1887. (*Agaricus falcifolius* Mont. Syll. Crypt. 127. 1856.) Described from specimens collected by Sullivant at Columbus, Ohio, growing in clusters on logs and dead leaves. Type not seen.

Psathyrella hiascens (Fries) Quél. Champ. Jura Vosg. 123. 1872. (*Agaricus hiascens* Fries, Syst. Myc. **1**: 303. 1821.) Peck reported this species from New York on the basis of specimens collected by him in June under willows at West Albany, and drawn in color. They are thin, campanulate, and multistriate, with very long, slender stipes;—quite different in appearance from the drawings made by Oersted in Costa Rica. The spores of Peck's specimens are said to measure 12–16 x 8–10 μ.

Psathyrella rupincola (Mont.) Sacc. Syll. Fung. **5**: 1129. 1887. (*Agaricus rupincola* Mont. Syll. Crypt. 127. 1856.) Described from specimens collected at Columbus, Ohio, by Sullivant, in May, growing from fissures in rocks. Type not seen.

NEW COMBINATIONS

For the convenience of those who prefer to use the older nomenclature, the following species described as new in *Atylospora* are transferred to *Psathyra:*

ATYLOSPORA AUSTRALIS = **Psathyra australis**

ATYLOSPORA PRUNULIFORMIS = **Psathyra prunuliformis**

ATYLOSPORA STRIATULA = **Psathyra striatula**

NEW YORK BOTANICAL GARDEN.

UROCYSTIS AGROPYRI ON REDTOP

W. H. Davis

(With Text Figure 1)

On June 6, 1921, smutted plants of redtop, *Agrostis palustris* Huds. (*A. alba* L.), were collected at Madison, Wisconsin, and microscopic examination showed the smut to be *Urocystis agropyri* (Pruss.) Schroet.

The hosts and host ranges reported by Clinton in *North American Flora* **7**: 58. 1906 are as follows: *Agropyron divergens* Nees (*Agropyron spicatum* (Pursh) Scribn. & Smith), Washington; *A. occidentale* Scribn. (*A. smithii* Rydb.), New Mexico; *A. repens* (L.) Beauv., Connecticut, Massachusetts and Vermont; *Bromus ciliatus* L., Iowa; *Bromus* sp., Minnesota; *Calamagrostis canadensis* (Michx.) Beauv., Oregon; *Elymus arenarius* L., Greenland; *E. canadensis* L., Illinois, Iowa, Kansas, Missouri, Nebraska and Wisconsin; *E. robustus* Scribn. & Smith; *E. virginicus* L., Illinois and Wisconsin; *E. sp.*, Colorado and Minnesota.

On redtop, the general appearance of the sori on the parts of the plant is the same as described for other hosts. The pustules form on the exposed culm, leaf sheath and blade, rhachis and rhachilla and are especially numerous on the leaves near the top of the culm. Striae, varying from 0.5 mm. in length to that of the whole leaf, form between the leaf veins. When young, these striae are raised and covered with light-colored, epidermal tissue of the host which later ruptures forming a trough-like slit filled with the spore balls. After the dispersal of the spore balls, the tissues beneath the striae become transparent and finally the leaves are shredded longitudinally. The culm above the sheath of the last leaf is usually twisted and the black pustules either remain distinct or coalesce on small areas of the culm. Although the plants when observed were only partially in blossom, many of the highly in-

fected panicles and some of the infected, lower leaves of the younger stools were dead.

Fig. 1. *Urocystis agropyri* (Pruss.) Schroet. on redtop. *A*. Smutted redtop plant (× 0.5), showing (1) shredding of leaf between the veins where the spore balls are deposited; (2) twisting of rachis. *B*. Photomicrograph of spore balls from the redtop plant shown in *A* (× 400); (3) spore ball containing one fertile spore; (4) two fertile spores; (5) four fertile spores.

The spore balls are oblong-spheric to spheric, from 21 to 33 μ in length, occasionally 40 μ. The sterile cells vary from a very

light amber to a Brussels-brown, are oblong-spheric to sub-spheric, covering the fertile cell or cells. The spores vary from 1 to 4 in a spore ball, usually 1 or 2. The fertile spores are Brussels-brown, oblong-spheric to spheric or angular-spheric. The sides of the spores are often flattened where two or more are crowded together in a spore ball. The spores are 12 to 19 μ in length; the average length of 20 measured was 16 μ. Thus the spores and spore balls compare very favorably with those of *U. agropyri* as described by Clinton (l. c.).

Specimens were deposited in the Herbarium at the University of Wisconsin. The identification of the smut was verified by Dr. J. J. Davis, Curator of the Herbarium at the University of Wisconsin.

DEPARTMENT OF BOTANY,
MASS. AGR. COLLEGE,
AMHERST, MASS.

NEW JAPANESE FUNGI

NOTES AND TRANSLATIONS—XII

Tyôzaburô Tanaka

Gymnosporangium asiatícum Miyabe in Shokubutsugaku Zasshi (Bot. Mag.) Tôkyô, 17^{192}: 34. M. 36, ii, Feb., 1903 (nomen nudum); in Ideta's Nippon Shokubutsu Byôrigaku (Handb. Pl. Diseases in Japan) ed. 3, Tôkyô, Shôkwabô, M. 36, iv, Apr., 1903, 6. 214–217, fig. 50, 51 (nomen subnudum); Yamada in Ômori, J. & Yamada, G. Shokubutsu Byôrigaku (Plant Pathology) Tôkyô, Hakubunkwan, M. 37, ix, Sept., 1904, p. 303–306. (Japanese.)

Description by G. Yamada:

O. Pycnia epiphyllous on spots, first small, punctiform and orange-yellow, gregarious, few in number; pycnospores small, fusoid.

I. Aecia hypophyllous, on thickened, well-developed, brown spots having a beautiful, flavo-rubescent margin, very slender, 3–6 mm. high, cinereous; peridium tubular, not recurved in dehiscence, irregularly torn at the end, liberating reddish-brown aeciospores; aeciospores globose or sub-angular, minutely-verrucose, the pores several.

On *Pyrus sinensis* (Japanese sand-pear) and *Cydonia vulgaris*.

III. Telia foliicolous, forming reddish-brown, gelatinous masses, deep-fuscous when desiccated, pulvinate with sticky, orange-yellow teliospores; teliospores long-pediceled, orange-yellow, those produced on the outer part of the telium broad and short, thick-walled and deep colored, those formed in the inner part of the telium slender, thin-walled and light colored, readily germinating from the places near the septum; promycelia 1–2, rarely produced from the apex of the teliospore; sporidia 2–3 on a promycelium.

On *Juniperus chinensis* and *J. chinensis* var. *procumbens*.

The sporidia of III readily produce *Roestelia* (*R. koreaensis* P. Henn.) on Japanese pear leaves, according to the inoculation test conducted by Miyabe.

Ideta (under supervision of Miyabe) gives the spore characters as follows: "Teliospores 2-celled, fusoid, 45–70 x 20–25 μ, long-pediceled." (*In* Nippon Shokubutsu Byôrigaku ed. 4, pt. 2: 470. M. 44, 1911. Japanese.)

Notes: Sydow first described *Gymnosporangium japonicum* from the specimens on the branch of *Juniperus chinensis* collected by Shirai at Komaba, Tôkyô (*in* Hedwigia, Beibl. 38^3: (141) May–June, 1899), and later, Shirai succeeded in producing *Roestelia* (*R. koreaensis*) on Japanese pear leaves by inoculating with some mixed forms of *Gymnosporangium* found on the leaves and stems of *Juniperus chinensis*, and which he called *G. japonicum* (*in* Zeitsch. f. Pflkr. 10^1: 1–4, pls. 1–2. Apr., 1900). These results apparently induced many Japanese pathologists to believe that *G. japonicum* is the causal organism of the devastating Japanese pear-rust, though Miyabe clearly defines that *G. asiaticum* occurs only on the leaves. The first comprehensive description of *G. asiaticum* given by Yamada also limits the occurrence of the telia to the juniper leaf only, and Yoshino later showed that the pear-rust is caused only by the leaf-inhabiting form of *Gymnosporangium* (*G. asiaticum*) in the Kyûshû island, and not by the stem-inhabiting form which he never found existing in the island (*in* Shokubutsu-gaku Zasshi, Bot. Mag., Tôkyô, 19^{222}: 167–168. M. 38, vii, July, 1905. Japanese). Ideta also describes the telial stage from the leaf-inhabiting form only, though he was liberal in bringing the name *G. asiaticum* into the synonymy with *G. japonicum* in his latest description (l. c. ed. 4, pt. 2: 467, 469–470. 1911).

Despite the existence of the valid name *Gymnosporangium asiaticum* applied to the form on the juniper leaves, Sydow renamed the leaf-inhabiting form as *Gymnosporangium haraeanum*, based upon the material collected by K. Hara from Mino province (*in* Ann. Mycol. 10^4: 405. Aug., 1912). Using the fresh material taken from the juniper plant upon which Sydow's type was collected, Hara succeeded in producing pear-rust by inoculation (*in* Shokubutsugaku Zasshi 27^{319}: 348. T. 2, vii, July, 1913. Japanese). At the same time, Itô succeeded in producing rust on *Photinia villosa* by inoculating the stem-inhabiting form which he determined to be *G. japonicum* Syd. (*in* Shok. Zass. 27^{323}: 221–

222. Nov., 1913). Itô concludes, therefore, that the leaf-inhabiting *Gymnosporangium* (*G. haraeanum* = *G. asiaticum*) is the cause of the Japanese pear-rust (*Roestelia koreaensis*), while the stem-inhabiting form (*G. japonicum*) is connected with the *Photinia* rust (*Roestelia photiniae* P. Henn.). (*See* l. c. p. 221, and also *in* Byôchû-gai Zasshi, Journ. Pl. Prot. 4^3: 178–182. T. 6, iii, Mar., 1917. Japanese.) Jackson also succeeded in infecting sand-pear and quince with the teliospores from *Gymnosporangium koreaensis* Jacks. (= *G. asiaticum* = *G. haraeanum*) and recommended *G. photiniae* Kern (*in* Bull. N. Y. Bot. Gard. **7**: 443. Oct., 1911) to supersede *G. japonicum*, following Itô's successful inoculation. (*See* Journ. Agr. Res. **5**: 1006, 1007. Feb., 1916.) Dietel, on the other hand, made examination of aecia found on the leaves of *Cydonia vulgaris*, *Pirus sinensis* and *Pourthiaea villosa* (*Photinia villosa*) collected by Kusano at the Botanic Garden, Tôkyô, and brought altogether under one species *G. confusum* Plowr. (*in* Engler's Bot. Jahrb. 28^3: 286, May, 1900), but Itô states that *G. confusum* never occurs in Japan, though Shirai lists it in his Nippon Kinrui Mokuroku (A list of Japanese fungi hitherto known, Tôkyô, Nippon Engei Kenkyûkwai, M. 38, 1905, p. 39) and he also maintains that the first two must be identical with *G. asiaticum* and the third must be *G. japonicum* (*in* Byôchû-gai Zasshi 4^3: 180. Mar., 1917).

In Korea, pear-rust was known quite early and its connection with juniper was suspected by the Korean agriculturist Soh You-Koh in his work *Haing po chi* written as early as about 1845. (Shirai, *in* Ann. Phytopath. Soc., Japan 1^1: 2. Jan., 1918.) In Japan, Hori first noticed the connection of the pear-rust with juniper *Gymnosporangium* in 1892, and he studied the actual damage of the pear plantation in Okayama first in 1900. (*See* Hori's Shokubutsu Byôgai Kôwa [Lectures on plant diseases] v. 2. Tôkyô, Seibidô, t. 5, xi, Nov., 1916, p. 301–302 [Japanese].) The infection of quince (*Cydonia vulgaris*) by the pear-rust fungus was reported by Miyabe and all later investigators, but Sydow made it a new species giving the name *Gymnosporangium spiniferum* to the aecial stage. (*See* Ann. Mycol. **10**: 78. Feb., 1912.) Itô conceives this to be identical with *G. asiaticum* (l. c. p. 181), but

Kern brings this into the synonymy with *G. photiniae* (*in* Mem. N. Y. Bot. Gard. **6**: 246. Aug., 1916). Successful inoculation of *Cydonia japonica* by the pear *Gymnosporangium* was also reported by Yoshino (l. c. p. 168), Hori (l. c. p. 309) and Itô (l. c. p. 182). According to Yoshino (*in* Shok. Zass. 20^{232}: 91. M. 39, v, May, 1906. Japanese), Ideta (l. c. ed. 4, p. 467) and Itô (l. c. 4^{5}: 327), natural infection of European pear (*Pyrus communis*) is found but of slight extent, and Hori adds *Pyrus Toringo* and *Cydonia sinensis* as incidental hosts (*in* Hori's Nôsakumotsu Byôgaku, [Discourse on plant diseases], 7 impr. 1911. p. 292. Japanese). Ideta first reported that *G. asiaticum* occurs also on the leaves and stems of *Juniperus rigida* (*in* Shok. Zass. 18^{211}: 157–158. M. 37, viii, Aug., 1904. Japanese), but later he corrected the statement in accordance with Miyabe's inoculation tests, that the leaf-inhabiting form only can produce aecia on pear leaves (l. c. 18^{213}: 223. Oct., 1904. Japanese). Later investigators all agreed with Ideta's final statement (*see* Hara, in Engei no Tomo [Friend of Hort.] 13^{9}: 811–812. T. 6, ix, Sept., 1917. Japanese), except Itô who doubts these statements because only exceptional species can infect both the Sabina and Oxycedrus groups of juniper (*in* Byôchû-gai Zasshi 4^{3}: 182–183). R. Nodzu even suggested that the pear-rust infects several species of *Chamaecyparis* (*in* Shimane Kenritsu Nôji Shikenjô T. 4 Nendo Gyômu Kôtei, [Ann. Rept. Simane Agr. Exp. Stat. for 1915]. p. 93. Japanese), but his suggestion received little credit by succeeding authors. Yoshino, on the other hand, succeeded in obtaining rust on *Cydonia vulgaris, C. japonica* and the Japanese pear by infecting with a *Gymnosporangium* found on the small stems of *Juniperus chinensis* in the Saga prefecture (*in* Shok. Zass. 20^{232}: 91. May, 1906). He describes this stem-inhabiting telium as being "only swollen or expanded or globular, appearing quite different from the ordinary stem-inhabiting form which expands greatly with moisture into a tongue-like petal." This shows, according to Yoshino, that the telium of *G. asiaticum* occurs also on the small twigs of juniper in a form quite distinct from that of *G. japonicum*.

GYMNOSPORANGIUM YAMADAE Miyabe in Shokubutsugaku Zasshi (Bot. Mag.) Tôkyô, 17^{192}: 34–35. M. 36, ii, Feb., 1903 (nomen

nudum); Yamada in Ômori, J. & Yamada, G. Shokubutsu Byôrigaku (Plant Pathology) Tôkyô, Hakubunkwan, M. 37, 1904, p. 306–308, fig. 38 (Japanese).

Gymnosporangium Yamadai Miyabe ex Ideta in Nippon Shokubutsu Byôrigaku (Handb. Pl. Diseases in Japan) ed. 3, Tôkyô, Shôkwabô, M. 36, iv. Apr., 1903 (nomen subnudum); Miyabe *in* Ideta ditto ed. 4, pt. 2: 471–474, fig. 174. M. 44, 1911 (Japanese).

Description by G. Yamada and K. Miyabe combined:

I. Aecia hypophyllous, on more or less thickened, reddish-brown spots, cylindrical, thick, 0.4–0.5 mm. in diam., 5–8 mm. high; peridium fulvous, splitting into a fine lace-like network; peridial cells narrow and elongated, 60–80 x 20–24 μ, inner wall smooth, outer wall slightly verrucose, side wall tuberculate with short papillae and never making elongated ridges; aeciospores subglobose or polygonal, 16–24 μ in diam., wall thick, brown, finely verrucose, the pores 8, scattered.

On *Pyrus Malus* (Apple), *Pyrus spectabilis*, and *P. Toringo*.

III. Telia caulicolous, from a perennial mycelium, appearing on reddish-brown, spheric swellings of the host stem, of somewhat shining appearance, disclosed by the rupturing of the cork in irregular fissures, flavo-rubescent, flat, petal- or tongue-shaped, irregular, deep-fuscous when desiccated; teliospores 2-celled, oblong, broad-ellipsoid, obovoid or clavate, upper cell always larger, frequently with thick-walled, obtuse papilla at the apex. 40–50 x 15–22 μ.

On *Juniperus chinensis* and *J. chinensis* var. *procumbens*.

Apple culture of the northeastern territories has been menaced by the disease. In Sapporo, Hokkaidô, it made its first appearance in 1902 with the introduction of *J. chinensis*, carrying the fungus from the south. According to Ideta (l. c. ed. 4 p. 472), Miyabe first found in 1904 the connection of apple rust with this particular *Gymnosporangium* inhabiting on the juniper stems. The aecial stage develops in July and August causing discoloration of apple leaves, which frequently results in defoliation. The telial stage appears on the juniper in April or May in the main island, and in May or June at Sapporo, Hokkaidô.

Illustrations: 4 text-figures by Yamada (l. c. p. 307) are given, showing telia on juniper branch, cross section on the swollen stem, teliospores and germination of teliospores.

Notes: The finding of aecia on *Pyrus spectabilis* by Shirai in Tôkyô was reported by Dietel as ? *Gymnosporangium claviaeforme* Jacq. (*in* Hedwigia **37**: 216. July, 1898) and by P. Sydow as *Gymnosporangium* ? *clavariiforme* (Jacq.) Rees (do. Beibl. 37^{7}: (207) Nov.–Dec., 1898). P. Hennings listed an aecium on *Pyrus Toringo* collected by Shirai at Nikkô as ? *G. clavariiforme* (Jacq.) Rees (*in* Engler's Bot. Jahrb. **28**: 262. Mar., 1900), and he later reported *G. clavariiforme* from Tôkyô, found by Hori on *P. spectabilis* (do. 31^{4-5}: 732. Aug., 1902). These are all likely to represent *G. Yamadae*. Under *G. Yamadae* Miyabe sp. nov., Kern presented a description of the aecial stage found on *Pyrus spectabilis* by Nambu at Tôkyô (*in* Bull. N. Y. Bot. Gard. 7^{26}: 466. Oct., 1911), and Sydow later described the telial stage under the same name from material presented by M. Miura (*in* Ann. Mycol. **12**: 159–160. Apr., 1914). Itô (*in* Byôchû-gai Zasshi, Journ. Pl. Prot. 4^{4}: 244–245. Apr., 1917) ventured, however, to bring this name into the synonymy with *G. chinensis* Long (*in* Journ. Agr. Res. **1**: 345. Jan., 1914) but all later investigators have considered the latter to be identical to *G. asiaticum* (= *G. haraeanum* = *G. koreaensis*). *See* Clinton, *in* Ann. Rept. Conn. Agr. Exp. Stat. for 1914 p. 15, 16. 1914; Jackson, *in* Journ. Agr. Res. **5**: 1006. Feb., 1916 and Kern *in* Mem. N. Y. Bot. Gard. **6**: 247–249. Aug., 1916.

GYMNOSPORANGIUM IDETAE Yamada ex K. Hara in Hara's Kwaju Byôgairon (Discourse on fruit diseases) Irie-chô, Shidzuoka-ken, T. 5, xi, Nov., 1916. p. 95 (Japanese): in Shidzuoka-ken Nôkwaihô (Journ. Agr. Soc., Shidzuoka prefecture) no. 287: 51–52. T. 10, ix, Sept., 1921 (Japanese).

Description from Hara's second article:

O. Pycnia epiphyllous, immersed, on orbicular or irregularly-orbicular orange-yellow spots of 5–15 mm. broad, which later turn into beautiful reddish-brown color, globose, with pointed apex; pycnospores fusoid, exude with mucilaginous substance, 8–10 x 3–3.5 μ.

I. Aecia gregarious, protruding from the host tissue, often with common base, cylindrical, grayish-yellow, with apex first rounded, later lacerating, 1–3 x 0.3–0.6 mm.; aeciospores broad-ellipsoid, globose or subangular, grayish-brown, verrucose, 18–28 μ in diam.

On *Amelanchier asiatica,* collected by Hara in Kawauye-mura, prov. Mino (Gifu-ken).

Description from Hara's first article:

III. Telia caulicolous, formed on fusoid swellings, roughened at first, later lacerate, exposed as purplish-brown masses; teliospores cylindric-clavate or rarely subfusoid, 1-septate, upper cell being broader and shorter, 45–75 x 15–20 μ, wall 1.5 μ thick, the pores 2 in both upper and lower cells near the septum, or 1 apically in the upper and 2 in the lower cell, germinating mostly from the apical pore; sporidia ellipsoid, ovoid or globose, 12–15 x 7–10 μ.

On *Juniperus rigida.*

Revised description of III in the second article of Hara:

"Telial masses chestnut-brown or purplish-brown, at first hemispheric, later becoming flat by union, or liquify, varying in size, smallest about 5 mm. in diam., largest several inches broad, occasionally surrounding the twig; teliospores 2-celled, rarely 1- or 3-celled; 2-celled spores with thick, colored wall, ellipsoid, broad-ellipsoid, subfusoid or ovoid, the cells equal in shape but lower cell being a little longer and narrower than the upper, upper cell occasionally papillate, not constricted or slightly constricted, both ends rounded or narrowed, 35–50 x 20–25 μ, those round ones measuring 28–33 x 18–28 μ, wall 1.5 μ thick, the pores 2 or 1, mostly one apical in the upper cell, two lateral near the septum in the lower cell; colorless spores ellipsoid, cylindrical or fusoid, the cells unequal, upper cell larger and flatter, lower cell cylindrical or tapering toward the pedicel, 50–55 x 16–23 μ, wall 1 μ thick, the pores one apical in the upper cell, or two near the septum as in the lower cell; 3-celled spores elongated, contents brown or yellow-rust color, 1-nucleate, 65–75 x 18–20 μ; pedicels cylindrical, very long, hyaline, 3–5 μ thick; promycelia clavate or cylindrical, 3-septate; sterigmata 3–4; sporidia ellipsoid ovoid or reniform, 10–15 x 7–10 μ."

Related to *G. Miyabei* Yamada & Miyake much closer than to *G. japonicum* Syd. Inoculations by Yamada and by Hara, conducted independently, resulted in the formation of aecia on *Amelanchier asiatica.*

Notes: The telial stage found on *Juniperus rigida* was first identified as *G. tremelloides* Hart. (Hara in Shok. Zass. 27[313]:

67. T. 2, i, Jan., 1913. Japanese). This identification was made by Sydow according to Hara's second report (l. c. 27^{319}: 348. T. 2, vii, July, 1913. Japanese), but as he had formerly succeeded in inoculating *Amelanchier* he considered this to be identical, at least partly, to *G. juniperinum* mentioned by Shirai in his "List" p. 39. Hara later obtained materials from Yamada who proposed the present scientific name according to the results of his inoculation. *See* Engei no Tomo (Friend of Hort.) 13^{9}: 812. T. 6, ix, Sept., 1917 (Japanese).

The present species was later acknowledged by Itô as a distinct species, differing from *G. clavariiforme* by having much flatter telia; from *G. amelanchieris* in the elongated shape of the teliospores; and from *G. clavipes* in the different shape of the pedicel of the teliospores. *See* Byôchû-gai Zasshi (Journ. Pl. Prot.) 4^{5}: 325–326. T. 6, v, May, 1917 (Japanese).

Hara's descriptions are based upon the specimens collected at Kawauye-mura, Mino province (Gifu-ken) (O. I. III.); various localities in Tôtômi province (Shidzuoka-ken) as Sakabe, Makinohara, Kasuisai, and Mikatagahara (III.).

Illustrations: Fig. 11, no. 6 in Hara's Kwaju Byôgairon shows 2 germinating teliospores and 2 sporidia.

GYMNOSPORANGIUM HEMISPHAERICUM K. Hara sp. nov. in Engei no Tomo (Friend of Hort.) 13^{9}: 813. T. 6, ix, Sept., 1917 (nomen nudum); in Dainippon Sanrin Kwaihô (Journ. Forest. Soc., Japan) no. 419: 16–18. T. 6, x, Oct., 1917. (Japanese.)

O. Pycnia epiphyllous, on orbicular orange-yellow spots, gregarious, first immersed, later piercing the epidermis with ostiola erumpent, globose or depressed-globose, 125–170 μ in diam., ostiolar filaments hyaline, resembling pedicels of pycnospores; pycnospores fusoid or ellipsoid, hyaline, 10–13 x 2.5–3 μ; pedicels filiform, 50–80 x 1–1.5 μ.

I. Aecia hypophyllous, cespitose or simply aggregate, conical or subcylindrical, delicate, brown, later cinereous or flavescent, 1–1.5 mm. high; peridium dehiscent only at the end; aeciospores globose or sub-angular, fulvous, verrucose, 20–28 x 18–25 μ.

On *Pyrus Zumi*.

Spots at first orange-yellow or yellowish-pink, orbicular, 1.5 mm. in diam., later enlarging attaining to 6 mm., becoming viscid and

then black-spotted on the upper surface, and producing hair-like aecia on the lower surface. At this stage, there develops a discolored area of pale-yellow or occasionally light-pinkish color around the spot.

III. Telia foliicolous or caulicolous, arising between scale-like leaves, oblate or hemispherical, fuscous or purplish-brown, later pulvinate, 1–5 mm. when desiccated, attaining to soy-bean size with moisture; teliospores subglobose, broad-ellipsoid or fusoid, rounded at both ends, sometimes papillate at the apex, occasionally with narrowed base, 2-celled, the cells almost equal-sized, constricted, 30–35 x 25–30 μ, wall thin, 1–1.5 μ thick, the pores 2 in each cell near the septum, or 1 apically in the upper, 2 in the lower cell; colorless spores fusoid or ellipsoid, commonly narrowed at both ends, 2-celled, each cell unequal, upper cell being 2–4 μ shorter than the lower, slightly or not constricted, 30–37 x 17–25 μ, wall thin, 1 μ thick, the pores 1 apical or 1–2 lateral in the upper, and 1–2 lateral in the lower cell, lateral pores being located near the septum; 1-celled teliospores ellipsoid or ovoid, rounded at both ends, or papillate at the apex, wall colored, 1–2 μ thick, the pores apical or lateral; pedicels cylindrical, long, 3–4.5 μ thick; promycelia cylindrical or elongated like hyphae, curved, 3-septate, 10–12 μ in diam.; sterigmata 3–4 on a promycelium, cylindrical, 5–6 μ long; sporidia ellipsoid or ovoid, 10–13 x 9–10 μ.

On *Juniperus chinensis.*

Type locality: Mino province (Gifu-ken) Kawauye-mura, Mar., 1917 (K. Hara).

The telia received a preliminary identification as *G. haraeanum* by T. Hemmi and S. Itô, but after examining well-developed teliospores Hara became aware of its great difference from common pear-rust *Gymnosporangium* and thought it to be a new form. The inoculation was then carried out and he obtained positive results on *P. Zumi*, and negative on *P. Malus, P. Toringo* and *P. sinensis.* Hara also collected aecia from naturally infected *P. Zumi* in August, 1916.

Hara observed, on the other hand, a type of sorus arising from the space between the scaly leaves of juniper, in this respect similar to a telium. This form, becoming globose or hemispheric in shape, is much lighter in color than the telium, being brown or rust-colored, pulvinate, composed of numerous spores arranged in

chains on the pedicel 3–4.5 μ thick (sometimes attaining to 9 μ thick in absorbing moisture). The spores are globose or broad-ellipsoid, 20–26 μ in diam., wall is thick, dark brown, 1.5–2 μ thick, contents being granular, rust-colored. In cutting the sori longitudinally, well-developed hyphae were observed, which were either apparently filling the enlarged host cells or running between them. The hyphae were colorless or fulvous, branching, 2–2.5 μ in diam. The spores did not germinate after several attempts, and that led Hara to consider these to be rudimentary urediniospores which had probably lost their function. He states that these peculiar spores occur also in the telia without forming independent sori of their own. He also ventures to add an account of this form to the generic character of *Gymnosporangium*. *See* Byôchû-gai Zasshi (Journ. Pl. Prot.) 6⁹: 754–755. T. 8, ix, Sept., 1919. (Japanese.)

GYMNOSPORANGIUM SHIRAIANUM K. Hara sp. nov. in Byôchû-gai Zasshi (Journ. Pl. Prot.) 6⁸: 681–687, 6⁹: 751–756. 1 pl. T. 8, viii–ix, Aug.–Sept., 1919. (Japanese.)

O. Pycnia epiphyllous, on orange-red or reddish spots of 5–10 mm. broad, immersed, globose or depressed-globose, 150–200 μ in diam., ostiolar filaments needle-shaped, narrowed at the apex, straight, containing orange-colored granules, 80–120 x 3–4 μ; pycnospores cylindric or ellipsoid, narrowed at both ends, hyaline, 8–12 x 3–4 μ; pedicels linear, narrowed at the apex, hyaline, 15–30 x 2.5–3 μ.

I. Aecia hypophyllous, on 7–10-times thickened spots, the surface of which undulate, orange-yellow with margin of orange or reddish color, cespitose in small group or irregularly scattered, at first cinereous with purplish-yellow, simply projecting, later elongating into cylinder or tube, 0.25–0.5 mm. in diam., 1–5 mm. high; peridium straight or curved, at first with rounded end, later dehiscent; peridial cells sub-hexagonal, elongated, or fusoid, rarely subglobose, lower ones much shorter and light-brown in color, 33–90 x 20–40 μ, outer wall parallel-striated, 4–7 μ thick; aeciospores globose, ovoid or polygonal, fulvous, 18–23 x 16–18 μ, wall verrucose, 1–2 μ thick, the pores 6–14, pedicel linear, variable in length, 4–5 μ in diam.

On *Pyrus sinensis*.

Type locality: Tôtômi province (Shidzuoka-ken) Mikatagahara, June 6, 1919 (K. Hara).

III. Telia foliicolous, epiphyllous, solitary or rarely 2–3 together, first subepidermal, later erumpent, minute, depressed-globose or oblate-ellipsoid, upper surface convex, purplish-brown or castaneous, lower surface more or less flat, light-brown or light-colored, looking as though attached to the substratum with pedicel-like body, 1–3 mm. in diam., 0.5–1 mm. high, becoming honey-color with moisture; teliospores broad-ellipsoid, fusoid or ovoid, rounded or narrowed at both ends, sometimes pointed at the apex, 2-celled (rarely 3- or 1-celled), usually equal-sized, sometimes upper cell being broader and shorter, lower just opposite, or rarely vice versa, constricted or not constricted, 30–50 x 15–25 μ, wall castaneous, 1.5–2.5 μ, the pores 2 in each cell near the septum, or 1 apically in the upper, 2 laterally in the lower cell; colorless spores oblong short-cylindrical or fusoid, rounded or narrowed at both ends, 2-celled, the cells equal or unequal, upper being larger or just opposite, mostly not constricted but rarely much constricted, wall fulvous, 1 μ thick, the pores mostly 1 apically in the upper, 2 laterally in the lower cell, or 2 in each cell near the septum; 3-celled spores clavate or oblong, not constricted at the septum or slightly constricted, 64–66 x 15–18 μ; 1-celled spores globose, ovoid or ellipsoid, 22–25 x 20–22 μ, round ones 22 μ in diam., wall 2–2.5 μ thick; pedicels cylindrical, very long, 4–9 μ thick, hyaline; promycelia at first cylindrical, later occasionally elongate into hyphal form of 5–7 μ thick, or simply curved, 3-celled and 5–8 μ thick; sterigmata filiform, 15–20 x 2–4 μ, terminated by sporidia; sporidia reniform or ellipsoid, orange-colored, 10–16 x 5–9 μ.

On *Juniperus littoralis*.

Type locality: Tôtômi province (Shidzuoka-ken) Mikatagahara, Mar. 20, 1919 (K. Hara), Mar. 21, 1919 (K. Yoshida), Apr. 7, 1919 (Y. Watanabe).

Illustrations: 1 black-and-white plate giving 15 figures to show aecial form on Japanese pear leaf: section of a pycnium, its ostiolar filaments, pedicels of pycnospore, pycnospores, section of an aecium, peridial cells, formation of aeciospores, mature aeciospores, telia on leaves of *J. littoralis*, a swollen telium, colored teliospores, colorless teliospores, germination of teliospores and sporidia.

The appearance of the aecial stage is quite similar to that of *G. asiaticum*, except the aecia look more or less purplish in color.

Notes: Sand-pear culture in the Mikatagahara region was given up some time ago on account of the virulence of rust, though

no *Juniperus chinensis* was found in the vicinity. After careful examination, Hara found *J. littoralis* growing wild in the region, which carried telia looking quite different from those of *J. chinensis*. Inoculation, using type material collected by Watanabe, proved that this telial form infects *P. sinensis* very easily, but *P. aucuparia* (*Sorbus aucuparia, S. japonica*) remained free (l. c. 6[9]: 751–752). Hara also suggested that the case reported by Ideta, regarding the leaf-inhabiting form of *Gymnosporangium* on *J. rigida* as the pear-rust organism, is one of misidentification of the host, because *J. littoralis* is often mistaken for *J. rigida* (l. c. p. 753).

SYNOPSIS OF JAPANESE GYMNOSPORANGIUM SPECIES*

I. TELIA ON STEM, CAUSING HYPERTROPHY

1. Telia on spheric swelling of the stem of *Juniperus chinensis*, and *J. chinensis* var. *procumbens*; aecia on *Pyrus Malus*, *P. spectabilis* and *P. Toringo*; aeciospores chestnut-brown.

GYMNOSPORANGIUM YAMADAE Miyabe, ex Yamada 1904, and Ideta 1911 (*G. Yamadai* Miyabe).

Syn. *G. claviaeforme* Dietel, *non* Jacq.
G. clavariiforme Syd., P. Henn., *non* Rees.
G. chinensis Itô, *non* Long.

2. Telia on fusoid swelling of the stem of *Juniperus chinensis*, and *J. chinensis* var. *procumbens*; aecia on *Photinia villosa* (*P. laevis*); aeciospores yellowish-brown.

GYMNOSPORANGIUM JAPONICUM Syd. 1899.

Syn. *Roestelia photiniae* P. Henn. in Hedwigia **33**: 231, Aug., 1894. (Ex Itô, 1913.)
Roestelia pourthiaeae Miyabe in Shok. Zass. (Bot. Mag.) Tôkyô, 17[192]: 35. M. 36, ii, Feb., 1903 (Japanese). (Ex Itô, 1917.)
Aecidium pourthiaeae Syd. in Bull. Herb. Bois. 1900, no. 4: 3. (Ex Itô, 1917.)
Gymnosporangium confusum Diet., *non* Plowr. in Engl. Bot. Jahrb. **28**: 286. May, 1900 *pro parte*. (Ex Itô, 1917, p. 180.)
G. photiniae Kern. 1911.

* In looking over this synopsis, Prof. Miyabe kindly made the following comments:

(1) The plant here called *Juniperus chinensis* var. *procumbens* should be *J. chinensis* var. *Sargenti*, since *J. procumbens*, according to E. H. Wilson, represents an entirely different plant.

(2) The plant here called *Juniperus littoralis* is better called *J. conferta*, in accordance with modern classification.

(3) The apple rust fungus probably had been existing in the prefecture of Aomori for centuries, where the wild crab apple is found common.

3. Telia on fusoid swelling of the stem of *Juniperus rigida;* aecia on *Amelanchier asiatica*; aeciospores chestnut-brown.

GYMNOSPORANGIUM IDETAE Yamada ex K. Hara, 1916, 1921.

Syn. *Gymnosporangium tremelloides* Syd., *non* Hartig. (Ex Hara.)

G. juniperinum Shirai pro parte, *non* Fries. (Ex Hara.)

4. Telia on fusoid swelling of the stem of *Chamaecyparis pisifera, Ch. pisifera* var. *plumosa,* and *Ch. pisifera* var. *squarrosa;* aecia on *Pyrus Miyabei* and *P. Aria* var. *kamaoensis*; aeciospores yellowish-brown.

GYMNOSPORANGIUM MIYABEI Yamada & Miyake in Shok. Zass. (Bot. Mag.) Tôkyô, 22^{253}: 21–28. Feb., 1908.

Syn. *Roestelia solitaria* Miyabe in Shok. Zass. 17^{192}: 35 M. 36, ii, Feb., 1903. (Ex Yamada & Miyake.)

R. solenoides Diet. in Engl. Bot. Jahrb. **32**: 631. June, 1903. (Ex Yamada & Miyake.)

Gymnosporangium solenoides Kern in Bull. N. Y. Bot. Gard. **7**: 450. Oct., 1911.

II. TELIA ON LEAF OR ON GREEN STEM, NOT CAUSING HYPERTROPHY

5. Telia conic or spheric, on *Juniperus chinensis, J. chinensis* var. *procumbens,* and *J. rigida*; aecia on *Pyrus sinensis, Cydonia vulgaris, C. japonica,* and *Pyrus communis*; aeciospores yellowish-brown, 18–22 × 18–21 μ (P. Henn.).

GYMNOSPORANGIUM ASIATICUM Miyabe, ex Yamada, 1904.

Syn. *Roestelia koreaensis* P. Henn. in Monsunia 1: 5. 1900. (Ex Yamada.)

Gymnosporangium japonicum Shirai, *non* Syd. pro parte.

G. confusum Diet., *non* Plowr. pro parte. (Ex Itô, 1917.)

G. spiniferum Syd. (Ex Itô, 1917.)

G. haraeanum Syd. 1912.

G. chinensis Long. (Ex Kern, Jackson).

G. koreaense Jacks. 1916.

6. Telia oblate or hemispheric, on *Juniperus chinensis*; aecia on *Pyrus Zumi*; aeciospores yellowish-brown, 20–28 × 18–25 μ (K. Hara).

GYMNOSPORANGIUM HEMISPHAERICUM K. Hara. 1917.

7. Telia depressed-globose or oblate-ellipsoid, on *Juniperus littoralis*; aecia on *Pyrus sinensis;* aeciospores yellowish-brown, 18–23 × 16–18 μ (K. Hara).

GYMNOSPORANGIUM SHIRAIANUM K. Hara. 1919

UNDESCRIBED OR QUESTIONABLE SPECIES REPORTED FROM JAPAN

1. Telia on *Juniperus nipponica*; aecia on *Sorbus japonica* (*Pyrus aucuparia* var. *japonica*) and *S. sambucifolia* var. *pseudogracilis* (*P. aucuparia*).

GYMNOSPORANGIUM ALPINUM Yamada ex Hara in Byôchû-gai Zasshi (Journ. Pl. Prot.) 6^{9}: 754. T. 8, ix, Sept., 1919 (nomen nudum).

Syn. *Gymnosporangium juniperi* Itô, *non* Link, based upon Miyabe (1903) and Ideta (1911). In Byôchû-gai Zasshi 4^{4}: 246. T. 6, iv, Apr., 1917 (Japanese). (Ex Hara, l. c.)

G. juniperinum Miyabe, Shok. Zass. 17: (35), *non* Fries (Aecia only; on *Pyrus aucuparia.* 1903). Ideta; aecia on *Sorbus japonica,* telia on *Juniperus nana* (?) 1911. Also Yamada, 1904, p. 308; Shirai List ed. I, p. 39 pro parte.

2. Telia on unknown host, collected by Miyabe in Karafuto (Saghalien).

GYMNOSPORANGIUM CLAVARIAEFORME (Jacq.) Rees. Ex Ideta, 1911, p. 474–475.

(Collected by Miyabe in Karafuto on *Juniperus nana*, ex Hara, l. c.)

(Shirai, List ed. I, p. 39, *pro parte*. Aecia on *Sorbus* sp.: List ed. 2, p. 265, aecia on *Pyrus*.)

3. Telia on unknown host; aecia on *Photinia villosa*.

GYMNOSPORANGIUM BLASDALEANUM Kern, 1911 p. 438; 1916, p. 250.

Syn. *Aecidium pourthiaeae* Syd. (Ex Kern.)

4. Host entirely unknown.

ROESTELIA CANCELLATA Reb. ex Matsumura, Shokubutsu Meikwan, Index Pl. Japon. vol. 1: 171. M. 37, ii, Feb., 1904; Shirai List ed. 1, p. 88 (*Gymnosporangium Sabinae* for the synonym).

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